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CATECHISM OF THE LOCOMOTIVE.

BY M. N. FORNEY, *Mechanical Engineer.*

PART XVIII.

COMBUSTION.

QUESTION 360. *What is meant by combustion?*

Answer. By combustion is meant the phenomenon ordinarily called burning, as when a piece of wood or coal or a candle is burnt. In reality combustion is a union of one of the "chemical elements," oxygen, of which the atmosphere is composed, with the elements which constitute the fuel.

QUESTION 361. What is meant by the term "chemical element?"

Answer. The science of chemistry has demonstrated that nearly all substances by which we are surrounded are composed of certain other substances, which latter, as far as now known, are not compounds, and are therefore called *elementary substances, or chemical elements*. Thus the air by which we are surrounded is composed of two gases, called nitrogen and oxygen; water is composed of hydrogen and oxygen, and coal chiefly of carbon and hydrogen. There are now over sixty of these elementary substances known. From no one of them have chemists been able to extract any material excepting the substance itself. These elementary substances will combine with others so as to form what is apparently a new material, but on weighing it it will be found that the weight of the new material is greater than the original elementary substance, showing that something was added to it which effected the change.

QUESTION 362. To what fact is this combination or combustion of elementary substances due?

Answer. It is owing to the fact—the exact reason for which is perhaps not yet understood fully—that the atoms of the elementary substances of which fuel is composed, that is hydrogen and carbon, and the atoms of oxygen, which forms part of the atmosphere by which we are surrounded, attract each other with great energy when they are excited into activity by the application of heat.

QUESTION 363. What phenomenon always attends chemical combination of substances?

Answer. Such combination always gives out heat, whereas their separation absorbs heat. It has further been proved by actual experiment that the amount of heat liberated by the chemical union of the same quantity or number of atoms of two or more substances is always the same, and that when, by any cause, the atoms thus joined are separated, exactly the same amount of heat is absorbed.*

QUESTION 364. In what proportions do the elementary substances combine with each other?

Answer. It is a law of chemistry that each of the elementary substances combines with the others in certain definite proportions only. These proportions vary for the different elements, and have been determined with great accuracy by scientific chemists. Thus, eight parts by weight of oxygen will combine with nitrogen and form atmospheric air, or the same proportion of oxygen will combine with hydrogen and forms water, or with carbon and forms carbonic acid, which is the deadly gas which accumulates at the bottom of wells.

Now oxygen always combines with other substances in the proportion of eight parts by weight, or by some simple multiple of eight, that is $8 \times 2 = 16$ parts, or $8 \times 3 = 24$ parts, etc. Each of the other elementary substances also has a certain fixed proportion in which it combines with others, and this proportion, which is usually given by weight, is represented by a number called its *chemical equivalent*. Thus 8 is the chemical equivalent of oxygen. Carbon combines with the elements in proportions of 6 and nitrogen in proportions of 14, so that 6 and 14 are the chemical equivalents of carbon and nitrogen. Now 8 parts by weight of oxygen can be made to combine with 14 parts of nitrogen, or $8 \times 2 = 16$ parts of oxygen will combine with 14 of nitrogen, but it is impossible to make say 12 parts of oxygen combine with 14 parts of nitrogen. We can combine $14 \times 2 = 28$ parts of nitrogen with 8 parts of oxygen, but no chemical process can make say 10 or 20 parts of nitrogen combine with 8 parts of oxygen. If 20 parts of nitrogen are mixed with 8 parts of oxygen, then the latter will combine with 14 parts of the former, but 6 parts of nitrogen will be left, and chemical combination will then cease.

The following table will give the chemical equivalents of the principal elements which enter into the process of combustion of the fuel used in locomotives :

	Chemical equivalent by weight.
Oxygen.....	8
Nitrogen.....	14
Hydrogen.....	1
Carbon.....	6
Sulphur.....	16

QUESTION 365. What effect do the proportions in which elements are combined have upon the substances which are produced by the combination?

Answer. A change in the proportions in which the elements are combined usually alters the entire nature of the substance so far at least as it affects our senses. For instance, oxygen unites chemically with nitrogen in different proportions, forming several distinct substances, each essentially different from the others, thus :

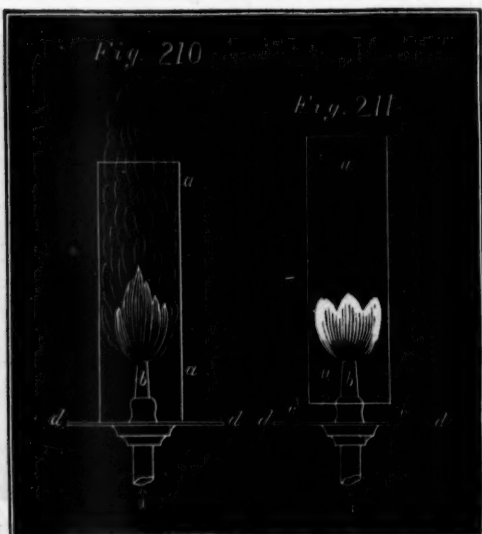
"The New Chemistry," by J. P. Cooke, Jr.

28	parts	of	Nitrogen	with	8	of	Oxygen	forms	Atmospheric Air.
16	01	00	00	00	00	00	00	00	Nitrous Oxide.
14	00	00	00	00	00	16	00	00	Nitric Oxide.
14	00	00	00	00	00	24	00	00	Hypnitrous Acid.
14	00	00	00	00	00	32	00	00	Nitrous Acid.
14	00	00	00	00	00	40	00	00	Nitric Acid.

We here find the elements of the air we breathe, by a mere change in the *proportions* in which they are united, forming distinct substances, which differ from each other as much as *air* and *laughing gas* (nitrous oxide) do from that most destructive agent *nitric acid*, commonly called *aqua fortis*.†

QUESTION 366. *What occurs when a fresh supply of bituminous coal is thrown on a bright fire in the fire-box of a locomotive?*

Answer. The fresh coal is first heated by the fire, and if a sufficient quantity is thrown in to prevent the immediate formation of flame,† a volume of such gas or vapor, usually of a dark yellow or brown color, is given off. The quantity evolved will be greatest when the coal is very small. This gas or vapor is commonly called smoke, but it does not deposit soot and in reality is not true smoke. If a sheet of white paper be held over the vapor as it escapes from the coal and there is no flame, the sheet will become slowly coated with a sticky matter of brown color difficult to remove, and having a strong tarry or sulphurous smell; whereas if a sheet of paper is held over smoke it will quickly be covered with black soot. The color and smell left on the paper in the first case are due to the tarry matter, sulphur, and other ingredients in the gas. Deprived of these coloring matters, the vapor is a chemical mixture of 2 parts of hydrogen and 6 parts of carbon, and is called carburetted hydrogen, and is nearly the same as the colorless gas by which our houses are lighted.|| A similar gas is generated at the wick of a burning candle or lamp and is consumed in the flame. Before the gas is expelled from the fresh coal the latter must be heated to a temperature of about 1,200 degrees, so that if 100 pounds at a temperature of 50 degrees is put on the fire 23,000 units of heat will be absorbed to heat the coal.¶ Nor is this all, as has been stated in answer to Question 37, when any substance is



vaporized a certain amount of heat apparently disappears, which has been called the *heat of vaporization or of gasification*. Average bituminous coal contains about 80 per cent. of carbon, 5 per cent. of hydrogen and 15 per cent. of other substances usually regarded as impurities. When the coal is heated up to about 1,200 degrees, the 5 per cent. of hydrogen unites with three times its weight of carbon, and thus 20 per cent. of the coal is converted into the gas described. In this process a large amount of heat is absorbed or becomes latent as it does when water or any other substance is converted into vapor. It will therefore be seen that the first effect of putting fresh coal on the fire is *to cool the fire*. This fact has an important bearing on the question of combustion and will be referred to hereafter.

QUESTION 367. How can the process of the combustion of the gas generated from the coal be best explained?

Answer. As this gas is substantially the same as ordinary illuminating gas, the manner in which it burns can perhaps be made clearer by examining the combustion of an ordinary gas light. As stated before, combustion is a chemical union of the oxygen which forms one of the elements of the air with the hydrogen and carbon of the fuel, or, in this case, gas. It should be clearly kept in mind that combustion is the result of this union, and that the oxygen is as essential to combustion as coal or gas, and in fact is the fuel of combustion just as much as coal or gas is. If we were to conduct a pipe from the external air into a vessel filled with coal gas we could *light the air* and it would burn in the gas as the gas burns in the air.

It will be noticed, however, that before either the gas or the air will burn, they must be lighted. Air and gas, even if mixed together in the same vessel, will not burn unless they are *lit*. This can be done by the flame of any burning material, or with a piece of metal heated to a very high temperature, or by an electric spark. In other words it may be said that the atoms of the two gases must be excited into activity by the application of heat, or communicating to the atoms what is called an *igniting temperature*, before chemical combination will begin. The chief feature which distinguishes

† Combustion of Coal and the Prevention of Smoke, by C. Wye Williams.

‡ Usually if more than two or three shovels full are thrown in there will be no immediate formation of flame.

¶ The quantity of heat required to heat coal is only about one-fifth that needed to heat the same weight of water to the same temperature.

combustion from other chemical union is the circumstance that the heat generated during the combination is sufficient to maintain an igniting temperature, and the necessity of doing so in order to continue the process is of very great importance in the combustion of coal in locomotive boilers, as will be shown hereafter.

QUESTION 398. How does an ordinary gas light burn after it is lit?

Answer. Under ordinary conditions the hydrogen, which is the most combustible of the two elements of which coal gas is formed, is the first to burn. This part of the combustion forms the lower bluish part of the flame. The combustion of the hydrogen thus separates it from the carbon which is then set free, and as carbon is never found in a gaseous condition when uncombined with other substances, it at once assumes the form of fine soot when the hydrogen is burned away from it. This fine soot, or pulverized carbon, is, however, intensely heated by the combustion of the hydrogen. Now carbon when heated to an igniting temperature will, if brought into contact with a sufficient quantity of oxygen, combine with it or be burned. Each particle of carbon thus becomes a glowing center of radiation, throwing out its luminous rays in every direction. The sparks last, however, but an instant, for the next moment they are consumed by the oxygen which is aroused to full activity by the heat, and only a transparent gas rises from the flame. But the same process continues; other particles succeed, which become heated and ignited in their turn, and it is to this combustion of the solid particles of carbon that the light which is given out by a gas burner or candle is due.*

QUESTION 369. Why does a gas burner, candle or other flame sometimes smoke?

Answer. Because the supply of oxygen is then insufficient to consume the particles of solid carbon which are set free and which then assume the form of soot. This can be illustrated if we cut a hole in a card, *d d*, fig. 210, so as to fit over an ordinary gas-burner, *b*. If we then light the gas and place an ordinary glass chimney, *a a*, over the burner and let it rest on the card, it will be found that the flame will at once begin to smoke, because very little air can then come in contact with the flame, and therefore when the fine particles of carbon are set free by the combustion of the hydrogen, instead of being burned as they would be if the air with its supply of oxygen were not excluded from the flame by the chimney, they escape unconsumed in the form of fine black powder or soot. If we raise the chimney up from the card, as shown in fig. 211, so as to leave enough space between them at the bottom of the chimney to permit air to enter to supply the flame with oxygen, the smoke will instantly cease, as the particles of carbon are then consumed. The same principle is illustrated in an ordinary kerosene lamp. It is well known that without a chimney the flame of nearly all such lamps smokes intolerably, whereas with a glass chimney and the peculiarly formed deflector which surrounds the wick the light burns without smoke unless the wick is turned up high. The effect of the chimney is to produce a draft, which is thrown against the flame by the deflector, and thus a sufficient supply of oxygen is furnished to consume all the particles of carbon, whereas without the draft produced by the chimney the supply of oxygen is insufficient to ignite all the carbon, which then escapes in the form of smoke or soot.

It must not, however, be hastily assumed that if the flame does not give out a bright light therefore the combustion is not complete. As has already been stated, the light of the gas flame is due to the presence of burning particles of solid carbon, which is set free by the combustion of the hydrogen with which it is combined. After it is separated from the hydrogen it immediately assumes a solid form. If the coal gas is mixed with a sufficient quantity of air before it is burned, the oxygen in the latter will be in such intimate contact with the former that the difference of affinity of oxygen for the carbon and hydrogen does not come into play, and as there is enough oxygen for all, the carbon is burned before it is set free, and as there are then no solid particles in the flame there is no light. This is illustrated by a "Bunsen burner," fig. 212, which is much used in chemical laboratories. It consists of a small tube or burner, *a*, which is placed inside of another larger tube, *b*. The latter has holes, *c, c*, a little below the top of the small tube. The current of gas escaping from the small tube produces what is called an *induced current* of air in the large tube. This air enters through the holes *c, c*, and is mixed with the gas in the tube *b*, and the mixture is burned at *d*. The flame from such a burner gives hardly any light, but the heat is intense, as is shown if a metal wire is held in it for a few seconds, as it will very soon glow with heat.

QUESTION 370. What important difference is there in the structure of the flame of a Bunsen burner and that of an ordinary gas-burner or candle?

Answer. The gas which escapes from the mouth *d* of the pipe *b*, fig. 212, is mixed with air, and therefore contains within itself the elements which only need to combine to produce combustion; whereas with an ordinary gas-burner or candle the air comes in contact with the flame only from the outside, or on its surface. This is shown better perhaps in the flame of an ordinary candle. The heat of such a flame distils a gas from the melted tallow, which is similar in nature to that which escapes from coal at a high temperature. Now by observing the candle very closely it will be seen that at the bottom close to the wick there is very little combustion, as the gas there first escapes from the wick and is not heated to a sufficiently high temperature to burn freely. A little above the lowermost part the flame is of a pale bluish color, which is due to the combustion of the hydrogen. Above that, where the carbon is set free, its particles glow with heat imparted by the burning hydrogen and are then consumed by uniting with the oxygen of the air. The combustion occurs only at the surface of the flame, the inside being a mass of combustible gas which cannot burn until it in turn comes in contact with the

**The new Chemistry, by J. P. Cooke, Jr.

oxygen of the air. This can be proved by inserting one end of a small tube, fig. 213 (a pipe stem will do), which is open at both ends into the flame. The combustible gas will then escape at the other end and can easily be lighted with a match.

It will be found that the flame from the Bunsen burner is much more intense than that of an ordinary candle or gas-burner. The reason of this is that combustion takes place through the whole mass of its flame, whereas an ordinary flame burns only at its surface. For this reason common gas jets are arranged so that the flame will be flat, thus exposing as much surface to the air as possible, and, as explained in answer to Question 321, in describing the lamps for head lights, their burners are usually made with a circular wick, through the center of which a current of air circulates. This arrangement exposes a larger surface of the flame to the air, and also with the aid of a chimney furnishes an abundant supply for combustion. In stationary boilers with long flues of a large sectional area the flame will often extend for thirty feet, showing that while combustion is going on only at the surface of the flame, it takes a long time to complete the process. The same thing is shown if a gas-burner is made with a single round hole. The flame will then be very long and liable to smoke at the top.

QUESTION 371. From the preceding considerations what may we infer to be necessary in order to consume coal gas perfectly?

Answer. In the first place, there must exist a certain degree of what chemists call "molecular activity," which is produced by heat, or what we have called the *igniting temperature*. The necessity of this is sufficiently obvious with ordinary gas-burners, as they must always be lit before they will burn. Now imagine that it was required to burn gas which was issuing from a hundred jets, of every variety of size, in a violent wind storm, or gusts of wind. Obviously it would be necessary to keep a lighted torch all the time to relight those which would be blown out. The gas in a locomotive fire-box is in reality burnt in a storm of wind more violent than any natural one. It is therefore necessary to be constantly ready to relight the streams of gas which the faintest breath would extinguish, or those of larger volume, and which owing to their size have caused a great reduction in temperature at the time and place of their birth, or when they assumed the gaseous form. To do this with certainty it is necessary to keep a constant temperature in the fire-box, high enough to ignite the gas which escapes or is distilled from the coal.

Second. That the chemical change in combustion consists simply in the union of the elements burned with the oxygen of the air; and therefore, to burn the gas perfectly without smoke or waste, enough air must be furnished to supply all the oxygen which is needed by the fuel.

Third. The air must be mixed with the gas, otherwise combustion will occur only at the surface of the flame, and will therefore be so slow that much of the gas will escape unconsumed.

It must be clearly kept in mind that no one or two of these requirements alone, without the third, will burn coal perfectly. What is needed is all three in combination. A very common error is to suppose that passing smoke over a hot fire, or in other words maintaining an igniting temperature, will alone effect perfect combustion, or that if a sufficient supply of air is admitted the fuel will be burnt completely. Neither of them will accomplish the object alone, and if the gas and air are combined, they must be thoroughly mixed with the burning gas in the fire-box.

QUESTION 372. What substances are produced by the combustion of coal gas?

Answer. The hydrogen of coal gas unites during combustion with oxygen in the proportion, as indicated by their chemical equivalents, of 1 part by weight of hydrogen with 8 parts of oxygen, the product of which is water. Of course at the high temperature at which the gases combine or burn the water is produced in the form of steam. That it is one of the products of combustion is shown every cold evening, when the insides of shop show-windows are covered with moisture, which is due to the steam that is given off by the burning gas-lights or lamps inside, and is then condensed against the cold glass.

Carbon combines with oxygen in two proportions: first, 6 parts of the former will unite with 8 of the latter, forming what is called *carbonic oxide*; or 6 parts of carbon will combine with 16 parts of oxygen, forming *carbonic acid gas*, or *carbonic dioxide*, as it is called in some of the new books on chemistry. It is probable that the former compound, that is carbonic oxide, is never or very rarely formed in the flame of coal gas; but as will be seen hereafter, is a very common and wasteful product of the combustion of the solid portion of the coal which is left after the gas is expelled from it. When there is not enough oxygen for the perfect combustion of the carbon in the flame, it smokes, and the carbon escapes in the form of soot. This, as will be shown, may in a locomotive fire-box help to form carbonic oxide after it leaves the flame.

QUESTION 373. What remains in the coal after all the gas is expelled by heat?

Answer.—What remains is ordinarily called coke, which, with the exception of some incombustible substances, such as sand, ashes and cinders, which the coal contains, is nearly pure carbon.

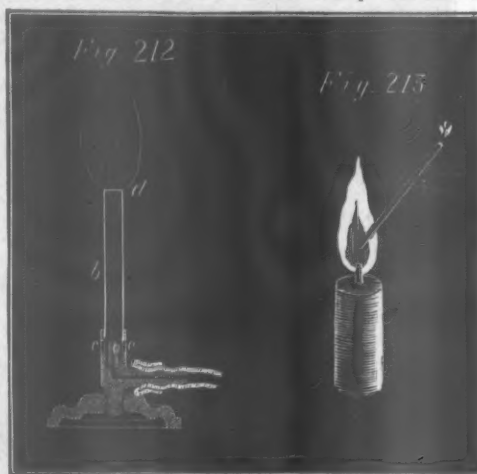
QUESTION 374. What is the chemical process of the combustion of coke?

Answer.—The solid carbon of the coke when raised to an igniting temperature; or, in other words, on being lit, unites with the oxygen in one of the two proportions already given; that is, if the supply of oxygen is sufficient 6 parts of the carbon of the coke unite with 16 parts of oxygen, forming carbonic acid gas, or carbonic dioxide. If, however, the layer of fuel on the grates is thick, or the supply of air is comparatively small, there will not be enough oxygen to supply 16 parts of the latter to each 6 parts of the carbon, so that when that occurs instead of combining in that proportion, and thus form-

ing carbonic dioxide, 8 parts of the oxygen will unite with 6 parts of carbon and form carbonic oxide. Now it should be carefully kept in mind that the heat of combustion is due to the union, or, as it is sometimes expressed, it is the clashing together of the molecules of the two elements which unite. If, therefore, only half the quantity of oxygen unites with 6 parts of carbon, evidently there will be less heat evolved than there would be if twice that amount of oxygen combined with the carbon. From carefully made experiments it was found that the total heat of the combustion of one pound of carbon when converted into *carbonic oxide* was 4,400 units, whereas when it was converted into *carbonic dioxide* 14,500 units were given out. It will thus be seen that it is extremely wasteful to burn coal without a sufficient supply of air to produce carbonic dioxide. The danger of waste from this cause is also increased by the fact that carbonic oxide is colorless, and, therefore, its production is not apparent, especially as most persons have the impression that when there is no smoke from a fire combustion is then perfect. It burns with a blue or yellowish flame when air is admitted into the fire-box, and its presence can be detected by these phenomena when the furnace door is opened.

QUESTION 375. How can the requisite quantity of air be supplied to the fire in a locomotive fire-box?

Answer. It is done in two ways: one is to keep but little coal in the grates, or in the phraseology of firemen, to "carry a light fire." The other method is to admit fresh air above the fire. If the latter plan is adopted when the supply of air through the grates is insufficient for perfect combustion the carbonic oxide will unite with the oxygen of the air above the fire, and thus a second combustion will take place, the product of which will be carbonic dioxide. It must be kept in mind, however, that not only must there be enough air supplied to the fire to consume the coke, but the gases which are distilled from the coal must also be supplied with oxygen in order to effect their perfect combustion. Even if enough air is admitted to consume the coke perfectly, if the carbonic dioxide thus formed is mixed with large quantities of smoke above the fire the solid carbon or soot of the smoke may then combine



with the dioxide and thus form carbonic oxide, if there is not enough fresh air present to furnish the requisite oxygen for the carbon in the smoke. A very common error is to suppose that smoke can be burned by passing it over or through a very hot fire. The smoke may thus be made invisible, it is true, but it does not therefore follow that it is consumed.

QUESTION 376. Is it possible to admit too much air into the fire-box of a locomotive?

Answer. Yes; probably all the air that is admitted which is not necessary for combustion, or, in other words, the oxygen of which does not combine with the fuel, is an injury and not an advantage, and instead of increasing diminishes the amount of water converted into steam. It does this in two ways; first, by reducing the temperature of the gases in contact with the heating surfaces, and second, by increasing the volume or quantity of the gases which must pass through the tubes. Heat is transmitted through the heating surface of a boiler in proportion to the difference of the temperature of the products of combustion on one side and the water on the other.†† Thus, if the temperature of the water on one side is 250 degrees, and the hot gases on the other is 500, there will be only half as much heat transmitted to the water in a given time as there would be if the gases had a temperature of 750 degrees. If the volume of gases is doubled by the admission of too much air, then obviously in order to pass through the tubes they must move at double the velocity, so that not only is their temperature diminished, but the time they are in contact with the heating surface is diminished in like proportion. This is shown by the effect of opening the furnace door, or of allowing the fire to burn away so that portions of the grate are left uncovered. The volume of cold air which will in either of these cases enter the fire-box will be so great that the pressure of the steam in the boiler will begin to fall at once.

QUESTION 377. What determines the amount of air which must be admitted to the fire-box of a locomotive to effect perfect combustion?

Answer. This depends chiefly upon the rate of combustion, that is, the number of pounds of coal consumed per hour on each square foot of grate surface. Of course if 100 pounds is burnt it will require twice the supply of air that would be needed if only 50 pounds were burnt.

QUESTION 378. How should the air be admitted so as to burn the coal perfectly?

Answer. In burning bituminous coal it has been shown that

†† This law is perhaps not absolutely correct, but is near enough for our present illustration.

there are two distinct bodies to be dealt with, the one coke, a solid, the other coal gas, which is of course a gaseous body. The combustion of each of these is necessarily a distinct process. If the requisite quantity of air is supplied to the burning coke, or solid portion of the coal, it will, as has been shown, be converted into carbonic dioxide and thus be perfectly consumed. If the supply of air is insufficient, the product of the combustion will be carbonic oxide, which is very wasteful. If, for example, there is a thick layer of coke on the grate, the air will enter and unite with the lower layer of coal and form carbonic dioxide, but as it rises there will not be enough air to supply oxygen to the carbon, and another equivalent of the latter will therefore combine with the carbonic dioxide and form carbonic oxide. It is evident, though, that the thinner the fire the easier it is for air to pass through it, and consequently the greater will be the quantity which will enter the fire-box. Nothing would seem easier than to regulate the thickness of the fire on the grates so that just the needed amount of air would pass through it. If coke alone was to be burned, undoubtedly very perfect combustion would be (and has been) effected in this way, but if a charge of fresh coal, say 100 pounds, is thrown on the fire the coal gas is very soon generated and escapes into the fire-box. This gas needs an additional amount of air for its combustion. It would seem that this could be supplied by reducing the thickness of the fire still further, so that more air would pass through it than was needed for the combustion of the coke. If this was done, then too much air would pass through the coke after the gases had all escaped from the fresh coal and were burned. Besides the passage of the air would be the most restricted after the fresh charge had been put on the fire, just at the time when the most is needed. This difficulty might be overcome if a constant supply of fresh coal just equal to that consumed were kept on the fire all the time, and the thickness of fuel on the grates was then regulated just so as to admit air enough for the combustion of the coke and also that of the gases, the production of which would then be uniform. An approximation to this method of feeding the fire is, in fact, what is aimed at on most locomotives, and tolerably good results are thus produced.

Two difficulties are, however, encountered in this method. In the first place it is impossible to feed a fire continuously with a shovel. There will be intervals between each charge which is thrown in so that the supply is not uniform, even if the charges do not consist of more than a portion of a shovel-full at a time; and if the fire was fed in this way as uniformly as possible it would then be necessary to open the furnace door every time fresh coal was put on the fire, and so much cold air would thus be admitted that more would be lost by lowering the temperature of the boiler than would be gained by the improved combustion.

Another difficulty also is encountered in this method of burning coal in locomotives. In order to admit enough air through the fire it is necessary to keep the latter so thin on the grates that the violent draft produced by the blast lifts the coal from the grate-bars and carries the lighter particles through the flues unconsumed. It is thus extremely difficult to keep the grate uniformly covered with coal, and if it is not, the air will enter in irregular and rapid streams or masses through the uncovered parts, and at the very time when it should be there most restricted. Such a state of things at once bids defiance to all regulation or control, so that it is found almost uniformly that firemen of locomotives keep enough coal on the grates to avoid the danger of "losing their fire," as they express it; that is, having all the burning coal drawn through the tubes by the blast. Now, on the control of the supply of air depends all that human skill can do in effecting perfect combustion and economy; and until the supply of fuel and the quantity on the bars be regulated, it will be impossible to control the admission of the air.††

Another method of feeding locomotive boilers is to pile up the coal in the back part in a thick layer and slope it downward towards the front, so that there is a comparatively thin fire in front. The mass piled up at the door becomes converted into coke, and the production of gas from the coal is more gradual and uniform than it is when only a small quantity is thrown in at a time, and therefore a more uniform supply of air is needed for its combustion. But it is apparent that very little air can pass through the thick heap of coal at the back part of the fire-box, and that therefore all, or nearly all, the air which enters it must come in through a comparatively small portion of the grate. It will of course be difficult to admit the requisite quantity, for the reasons already stated.

It is consequently apparent that it is practically impossible to admit enough air through the grates to effect a constantly perfect combustion of bituminous coal. It is, therefore, necessary to admit a portion of the air above the fire. In doing this, however, in order to effect perfect combustion it must in the first place combine with the gases at an igniting temperature, and, as has been shown, must be thoroughly mixed with them, so as to be able to enter into chemical combination, or, in other words, burn the gases. If too much air is admitted, it will reduce the temperature in the fire-box so much that the gases will not ignite; or if it is admitted in strong currents, the air and the gases will flow side by side like the currents of two streams of water, the one muddy and the other clear, which, as is well known, mingle very slowly. Besides, if a hot stream of gas encounters a strong stream of cold air and comes in contact with it only at its surface, the latter will be cooled down below the igniting temperature; whereas if the two had been intimately mixed in the right proportions, the whole mixture would have been hot enough to burn. It is therefore of the utmost importance that the air which is admitted above the fire should enter the fire-box in many small jets. None of the openings for its admission should exceed $\frac{1}{2}$ inch in diameter. With the violent

†† The Combustion of Coal, by C. Wye Williams.

draft in a locomotive fire-box there is an extremely brief period of time for chemical combination to take place after the gases are expelled from the coal and before they are hurried into the tubes. As the chemical action between the gases and the oxygen can only take place when the two are in intimate contact, too much pains cannot be taken to distribute the currents of admitted air and thus mix them with the combustible gases. In many cases means are adopted to delay the air and the gases in the fire-box as to give them time for chemical combination or combustion before entering the tubes.

ANNUAL REPORTS.

Michigan Central.

The line owned in fee by this company is that from Detroit to Chicago, 255 miles. The other lines worked by it are all leased, though most of them were largely or almost wholly constructed by it, and it owns a large part of the stock in some, and will apparently have a perpetual lease free of rent of one line after paying its bonded debt, which it has contracted to do, though it does not and will not own its stock.

	Miles.
Main Line.....	285
Air Line, Jackson to Niles.....	103
Air Line, Niles to South Bend.....	10
Jackson, Lansing & Saginaw.....	236
Grand River Valley.....	94
Kalamazoo & South Haven.....	40
Joliet & Northern Indiana.....	44
	812

The rental of the Jackson & Niles Air Line is the interest of \$1,000,000 8 per cent. bonds and the principal when due; of the Niles & South Bend the interest on \$200,000 8 per cent. bonds; of the Jackson, Lansing & Saginaw, interest on \$4,248,000 8 per cent. bonds and \$70,000 per year, more than one-third of which latter amount goes back to the Michigan Central as the owner of stock; of the Grand River Valley, interest on \$1,500,000 8 per cent. bonds and \$24,500; for the Kalamazoo & South Haven, interest on \$710,000 8 per cent. bonds; for the Joliet & Northern Indiana, we cannot ascertain the amount of rental from the reports, but it has outstanding \$800,000 of 8 per cent. bonds and \$900,000 of stock on which an 8 per cent. dividend was paid at one time. The capital account includes large amounts for construction of branch lines and a considerable amount in stocks and bonds of various companies.

The equipment at the close of the year ending with May, 1874, consisted of 210 locomotives; 82 first-class and 34 second-class coaches, 3 postal, 39 baggage and mail cars—158 passenger-train cars; 96 conductors' cars, 493 stock, 1,843 box, 474 Blue Line, 21 refrigerator, 1,332 platform cars—4,259 freight-train cars; 2 derrick and 4 pile-driver cars. There was no change in the number of locomotives, an increase of 4 first-class and a decrease of 6 second-class coaches, a decrease of 3 baggage cars, and increase of 4 conductors', a decrease of 10 stock, of 4 box, of 1 Blue Line, and of 6 platform cars. Altogether there were 5 less passenger-train cars and 17 less freight-train cars at the end than at the beginning of the year. The equipment of cars was insufficient, as is shown by the fact that cars of foreign roads ran 35,619,009 miles on the Michigan Central during the year, while Michigan Central cars ran but 13,447,623 miles on foreign roads.

The balance sheet of the company foots up \$34,141,727. The Michigan Central property, however, is represented by the following stock and bonds:

Capital stock (\$66,092 per mile owned).....	\$18,738,204
Funded debt (\$37,667 per mile owned).....	10,735,000

The company, however, has guaranteed the \$1,000,000 of Air Line bonds, which are not a lien of the Michigan Central property. Of the bonded debt \$8,000,000 is in 7 per cent. consolidated mortgage bonds, and the rest in the three different issues of 8 per cent. bonds, but all due in 1882.

During the year the work done by the company on 812 miles worked was:

	1874.	1873.
Passenger-train mileage.....	1,076,225	1,030,594
Freight-train mileage.....	2,406,888	1,584,374
Miscellaneous train mileage.....	321,564	376,246
Switching.....	1,311,398	1,001,457
Total.....	5,116,005	3,992,371

The increase is about 28 per cent. and the increase in freight-train mileage 52 per cent. Probably the Air Line mileage was not included in the report of 1873-73.

The traffic consisted of:

	1874.	1873.
Way passengers eastward.....	302,385	355,845
" westward.....	361,833	348,262
Through passengers eastward.....	69,390	6,378
" westward.....	65,122	62,285
Immigrant passengers.....	18,715	22,224

Total passengers moved..... 877,445 852,332

The number of passengers carried was exceeded once (in 1866), but once only in the history of the company.

The mileage of passengers is not reported.

The freight moved during the last year was:

	Number tons.	Tonnage mileage.
Through east.....	306,792	221,639,460
Through west.....	141,273	39,566,967
Local east.....	364,895	31,361,611
Local west.....	280,994	20,833,041
Total through.....	948,066	261,206,436
Total local.....	645,889	52,194,652
Total east.....	1,171,687	253,001,080
Total west.....	428,067	60,400,008
Grand total.....	1,599,954	313,401,088

Of the tonnage mileage one-sixth is local and less than one-fifth west-bound, and of the through tonnage mileage only a little more than 16 per cent. is west-bound. Compared with the previous year there is an increase of 38 per cent. in through and a decrease of 8 per cent. in local traffic. The entire increase was in through traffic eastward, all other showing a decrease, and this an increase of nearly 50 per cent.

The following is a comparative statement of earnings and expenses of entire line, including branches:

	1873.	1874.	Increase or Decrease.	Per Ct.
Earnings.....	\$3,307,151 67	\$3,360,948 86	—\$53,797 19	0.27
Freight.....	4,662,873 82	4,936,961 93	—\$270,888 11	5.7
Miscellaneous.....	283,082 67	354,170 91	—\$71,088 24	25.57
Totals.....	\$7,302,118 06	\$7,652,081 70	—\$350,963 64	4.55
Operating Expenses.....	\$4,840,554 87	\$5,316,549 64	—\$475,994 77	9.8
Taxes.....	146,370 59	207,092 75	—\$60,722 16	41.5
Totals.....	\$4,986,925 46	\$5,523,642 39	—\$536,716 93	10.76
Net earnings.....	\$2,315,192 60	\$2,128,439 31	—\$186,753 29	8.0
Ratio of expenses to earnings, including taxes.....	68 29-100	72 35-100	+4 6-100	
Ratio of taxes to net earnings.....	6 29-100	9 64-100	+3 35-100	

The following are the separate earnings and expenses of the main line and branches.

	Gross Earnings.	Expenses.	Net Earnings.	Ratio of Expenses.
Main Line.....	\$6,312,788 23	\$4,479,786 16	\$1,833,002 07	70.9 p.c.
Joliet Division.....	155,166 42	183,494 53	—28,328 13	111.1 p.c.
Grand Riv. Val. Div.....	296,981 23	20,772 44	96,208 79	67.7 p.c.
South Haven Div.....	80,832 03	42,435 16	38,396 87	52.5 p.c.
Nunica Division.....	37,150 99	48,773 11	—11,622 12	131.3 p.c.
South Bend Div.....	20,949 09	11,631 68	9,317 41	55.5 p.c.
Jackson & Lan. Div.....	720,213 71	556,749 29	163,464 42	77.3 p.c.

Totals..... \$7,634,081 70 \$5,523,642 39 \$2,110,439 31 72.35 p.c.
*The Air Line being in reality a second track for the Main Line, the earnings and expenses of that division in the above are added to the Main Line.

Counting the Main Line as 388 miles long (its length plus the Air Line from Niles to Jackson), the gross earnings were at the rate of \$16,270 per mile on the Main Line; \$4,208, on the Joliet Division; \$3,159, on the Grand River Valley; \$2,821, on the South Haven; \$2,095, on the South Bend; and \$3,052 per mile on the Jackson, Lansing & Saginaw Division. None of the branch lines earns its rental; and the total loss on their account was \$375,891, against which should be placed the profit on traffic which is brought by these lines, and would not otherwise be received.

A division of the sources of the earnings of the 285 miles of Main Line shows that of the freight earnings 17 per cent. was from local east, 12½ per cent. from local west, nearly 59 per cent. from through east, and 11½ per cent. from through west. Compared with the previous year there was an increase of 17.8 per cent. in through freight earnings, and a decrease of 13.8 per cent. in local freight earnings. East bound freight earned no less than 70¼ per cent. of the total freight receipts.

Of the passenger earnings 46.28 per cent. were local and 53.72 per cent. through. Aside from emigrants there is not a great deal of difference between local east, local west, through east and through west. Compared with the previous year there is an increase of 5.03 per cent. in the through passenger earnings, and a decrease of 1.62 per cent. in local, and 23.54 in emigrant earnings.

The \$2,110,439 of net earnings were disposed of by devoting \$631,104 to the annual interest charge, and \$375,891 to the deficits of the leased lines, and the balance mostly toward reducing the floating debt. The expenditures for construction were \$2,060,637 during the year, \$1,093,394 for second track and steel rails, \$240,315 for new sidings, and \$632,507 for the extension, new shops and other structures. The bonded debt was increased by \$1,000,000 during the year, at the close of which the floating debt was \$1,066,453, being \$284,915 less than was reported last January.

A statement of the earnings per ton per mile on the Main Line is as follows:

	1874.	1873.	Local east.	Local west.	Through east.	Through west.	Grand total.
Through east.....	1.09 cts.	1.26 cts.	2.24 cts.	2.48 cts.			
Through west.....	1.15 " 1.37 "	1.37 " 1.55 "	2.50 " 2.55 "				
Total through.....	1.10 " 1.28 "	1.28 " 1.51 "	2.34 " 2.51 "				
			1.30 cts.	1.57 cts.			

This shows a decrease in the average rate on every class of freight business, amounting on the average to more than 17 per cent., which sufficiently accounts for the unsatisfactory returns to the stockholders.

TRAFFIC AND EARNINGS.

The earnings of the Rutland Railroad for 13 months ending January 1, 1874, were as follows:

Earnings.....	\$1,135,062 13
Expenses (70.42 per cent.).....	799,256 23

Net earnings..... \$335,806 90

The earnings of the St. Paul & Sioux City and Sioux City & St. Paul railroads for June were: 1874, \$70,092.68; 1873, \$67,071.10; increase, \$2,961.58, or 4½ per cent. For the six months ending June 30 the earnings were: 1874, \$372,648.56; 1873, \$305,020.86; increase, \$67,627.70, or 22½ per cent. Earnings per mile for the six months: 1874, \$1,390; 1873, \$1,130.

The earnings of the Denver & Rio Grande Railway for the third week in July were: 1874, \$9,388; 1873, \$8,089; increase, \$1,299, or 16½ per cent.

The shipments of through freight eastward over the Central Pacific Railroad during June were as follows: San Francisco, 4,764 tons; interior points, 465 tons; total, 5,229 tons, or 523 carloads. The principal items were: Wool, 2,753 tons; tea, 577 tons; wine, 317 tons; salmon, 305 tons.

The Buffalo Commercial Advertiser gives the following statement of receipts of flour and grain in that city for the seven months ending August 1:

	1874.	1873.
By railroad.....	1,129,352	17,033,321
By lake.....	614,765	56,405,589
Totals.....	1,744,117	43,438,910

The railroads thus brought nearly 60 per cent. of the flour and 39 per cent. of the grain this year, and 34 per cent. of the grain last year.

The shipments of grain eastward for the same period were:

	1874.	1873.
By canal, bushels.....	19,835,554	17,265,293
By rail.....	9,912,901	4,675,315
Totals.....	29,748,455	21,940,608

The railroad shipments were 16½ per cent. this year, and 21 per cent. last.

The receipts of canal tolls on the Erie Canal at Buffalo from the opening of the season up to August 1 were: 1874, \$593,709; 1873, \$533,462; increase, \$60,247, or 11½ per cent. The number of boats cleared were: 1874, 3,652; 1873, 3,448; increase, 204, or 5½ per cent.

The shipments of peaches from Wilmington, Del., for the first week of the season amounted to 137 car loads, or 68,500 baskets.

The earnings of the Chicago, Milwaukee & St. Paul Railway for the month of July were: 1874, \$749,200; 1873, \$834,341; decrease, \$85,141, or 10½ per cent.

The receipts of cotton at New Orleans for the eleven months from September 1, 1873, to August 1, 1874, as compared with the previous year, were as follows:

	1873-74.	1872-73.
New Orleans, Jackson & G. N. RR.....	276,076	270,013
Mississippi River and bayous.....	586,942	590,123
Red River.....	170,488	186,085
Ouachita River.....	109,733	103,303
Arkansas River.....	45,936	58,128
Totals.....	1,182,775	1,207,652

Railroad receipts were 23.4 per cent. of the whole this year and 22.4 the year previous.

PERSONAL.

—With the abolition of the Construction Department, which had charge of all new work on the New Jersey lines leased by the Pennsylvania Railroad Company, Mr. Ashbel

Welch retires from the position of Chief Engineer of Construction. It is understood, however, that Mr. Welch has been requested to remain with the company as Consulting Engineer, in which position, or indeed in any other, his great abilities and long experience as an engineer, and his thorough and intimate knowledge of the New Jersey lines must render his services of great value.

—Mr. Theodore I. Heizman has resigned his position as Chief Engineer of Maintenance of Way of the Pennsylvania Railroad.

—Mr. A. C. Bean, of White River Junction, Vt., Road Master on the Southern Division of the Vermont Central Railroad, was last week presented by the men under his charge with a valuable gold watch and chain, costing \$315.

—President Chapin, of the Boston & Albany Railroad Company, has sailed for Europe. His trip, it is understood, is for rest and recreation, not business.

—The Pittsburgh, Cincinnati & St. Louis Company has brought suit against Lyman S. Cotton, Chief Engineer of the Little Miami Division, to recover \$16,000, which sum, it is alleged, he has embezzled from the company. The fraud charged was in the purchase of real estate for the approaches to the Cincinnati Bridge, Mr. Cotton having, it is said, received more money from the company than he paid to the property owners. He left Cincinnati several days before the commencement of the suit and his present whereabouts is not known.

—Mr. Stanley Mansfield has resigned his position as Superintendent of the Nashua, Acton & Boston Railroad, which he has held since the opening of the road.

—Mr. T. W. Spencer has resigned his position as General Superintendent of the Utica & Black River Railroad, and has taken a contract for the building of the extension of the road from Theresa, N. Y., to Morristown.

—Mr. Daniel L. Harris, President of the Connecticut River Railroad Company, sailed for Europe, August 1, on a short pleasure trip.

—The employees of the South & North Alabama Railroad recently presented Mr. M. Stanton, late Superintendent, with a handsome watch and chain, on the occasion of his leaving the road.

—Mr. Hiram Moore, Assistant Master Mechanic of the Rome, Watertown & Ogdensburg Railroad, died recently at Rome, N. Y. He had been in the employ of the company for 23 years.

THE SCRAP HEAP.

Railroad Manufactures.

The firm of Harbaugh, Mathias & Owens, owners of the Superior Rail Mills at Pittsburgh, has suspended payment, and has filed a petition for a settlement of the affairs of the firm in bankruptcy.

The American Manufacturer of July 30 says: The Pennsylvania Steel Works, at Baldwin, turned out one day last week the enormous quantity of 110 tons of steel rails. This is claimed to be the largest day's work ever performed by any similar works in this country.

The first installment of the Russian engines now being built by the Grant Locomotive Works at Paterson, N. J., has been completed, and is being made ready for shipment.

The Roger Locomotive Works at Paterson have made a small increase in the force employed, and, it is stated, have secured some orders on which work will be commenced shortly.

A Wide Bridge.

Speaking of the celebration of the Fourth in Philadelphia, the correspondent of the Iron Age says:

"The Girard avenue bridge, the widest bridge in the world, and probably as well built as any, was formally turned over to the city authorities and opened to the public. You have had several descriptions of this bridge, but I add again dimensions and cost:

Total length.....	1,400 feet
Total width.....	100 feet
Number and size of spans.....	2 of 197 and 3 of 197 feet
Length of sidewalk.....	863 feet
Number of piers, & abutments, 2.....	
Width of roadway.....	67½ feet
Width of each sidewalk.....	6½ feet
Greatest height from roadway to rock foundation.....	85 feet
Number of square feet of surface.....	160,000 feet
Cost per foot.....	\$4.80

The total cost was \$1,404,445, and, although less than a quarter of a mile long, the bridge contains as much material as is in a mile and a half of single-track railroad bridge of similar spans. A very attractive feature of the work is that each kind of material used is allowed to show what it is, iron not being treated to resemble stone, and color being applied only to distinguish parts."

Changing Gauge in England.

English journals note the change of 200 miles of the Great Western Railway, of the part known as the "Southwestern District," from the 7-foot to the standard gauge. The work was done within two days, only one rail being moved. The Great Western has been a cheap line to work with the broad gauge, but its isolation from the rest of the railroad system of the country could no longer be endured. There are three lines remaining of the wide gauge, which was adopted by the younger Brunel.

A Reflection on Erie Engineers.

The Port Jervis (N. Y.) Gazette says: "Recently a special order was issued by B. Thomas, Superintendent of Delaware Division, enforcing Rule 77 of the General Regulations: 'All Wild-Cat trains to carry white flags by day, and white light at night, on front of the engine.' It had become absolutely necessary, as some of our engineers' noses are so red (sun burnt) that the reflection of the headlight indicated them as extras carrying signals."

Prices of Rails in July.

Bigelow & Johnston report American iron at \$36 to \$60 currency, American steel at \$97½ currency, and foreign steel at \$90 gold. There have been no imports at the port of New York of iron rails this year, but the imports of steel rails amounted to 5,723 tons in July and 50,786 for the seven months. Last year for the same period the imports at that port were 48,343 tons of steel and 41,449 of iron. Bigelow & Johnston say:

"New Rails.—In foreign the transactions have been for lots in bond, and some considerable sales have taken place at low figures. The published reports, however, greatly exaggerate the quantity actually disposed of in this way, and the increased prices asked by holders has already had the effect of checking this exceptional business. For American there is a better inquiry, but the business consummated by no means meets the general expectation and need of our mills. Prices are a trifle firmer."

"Old Rails.—Trade has been very light all the past month in this market, but some large sales are reported from the interior at low prices, supposed about \$36 delivered at works. The supply all through the country is still in excess of the demand."



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Editorial Announcements.

Addresses.—Business letters should be addressed and drafts made payable to THE RAILROAD GAZETTE. Communications for the attention of the Editors should be addressed EDITOR RAILROAD GAZETTE.

Contributions.—Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies, the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and in their management, particulars as to the business of railroads, and suggestions as to its improvement. Discussions of subjects pertaining to ALL DEPARTMENTS of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.

Advertisements.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. We give in our editorial columns our own opinions, and those only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.

THE MICHIGAN CENTRAL REPORT.

Doubtless this report for the last fiscal year (ending with May last) will be disappointing to the stockholders. Two years ago the net earnings were not quite enough to pay the usual half-yearly dividend of 5 per cent. for the last half of the year, though it was paid, "it being thought better to make up the amount from the surplus than to interrupt the regularity of dividends, as it is probable that the earnings will be sufficient hereafter." But the next dividend was paid in stock, and for the three half-years following, including the last, no dividend has been paid. It was in the report referred to (for 1871-'72) that the President set forth the circumstances which had limited earnings and increased the proportion of working expenses, and explained the necessity of costly improvements to enable the road to do its work at a reasonable profit. He then said that such improvements would probably enable the road to do its work at an expense of not more than 60 per cent. of the receipts, instead of 70. Last year, the improvements having been vigorously prosecuted meanwhile, and the stockholders having received one dividend in stock while the other was passed, Mr. Joy gave an admirable account of the circumstances which had for the time rendered the stock unproductive, including the absolute necessity of improvements to lessen the cost of transportation, in order to save the company from ruin, and the circumstances which had influenced the management in leasing the numerous new branch lines, most of which were and are unprofitable. This latter policy has been much criticised, and Mr. Joy's defence of it was very striking. (The reader may find the points of it set forth on page 308 of our last volume.) The proportion of working expenses and taxes meanwhile had fallen from 71 to 68 per cent. for the whole system, and from 70 to 66 per cent. for the Main Line, on which the improvements were made, and with the increasing traffic, which the road was then prepared to carry cheaply, it was reasonable to suppose that the stockholders would very soon receive dividends again.

But the last report shows that while, in spite of the panic, the road has earned more than ever, the working expenses have risen from 68.3 to 72.3 per cent. for the whole system and from 66 to 68 per cent. on the Main Line, and the net earnings have fallen off by nearly 9 per cent. This is certainly an unsatisfactory result after the costly additions to the property which were of course intended to add to its profits, and there will doubtless be some who will claim that after all no economy has been secured by the millions which have been expended for

second tracks, steel rails, new sidings and large additions to the equipment. Nevertheless Mr. Joy was right, and his report shows it, although it does not perhaps present the fact in the clearest manner.

The confusion arises from considering the ratio of expenses to earnings as the criterion of cheapness and economy. It is nothing of the kind, as we have shown before. This proportion depends on two things: one the cost of doing the work, which is the element in which economy or extravagance is shown; the other the price received for the work, which has no necessary relation to the cost. Last year the Michigan Central carried freight on its main line at an average expense to it, exclusive of taxes, of 0.85 cents per ton per mile. Now if it had received 1.98 cents per ton per mile, as it did in 1869-'70, these working expenses would have been but 43 per cent., instead of 65.4, as they were, the actual average receipt being only 1.30 cents per ton per mile, which is little more than the expenses were in 1870. The fact is, the economy, so far as freight traffic is concerned, has been all that could have been reasonably expected, but the public and not the company has received the benefit of it. Shall, then, the stockholders say that it would have been better to have left the road as it was and done less work at the old higher cost and the old higher prices? The old higher prices, indeed! If the company could have in any way kept up prices we may be sure that the stockholders would never have thought of complaining; but the company, like all others situated as it is, has had to take what it could get, and this is a lower freight rate than has ever been reported by any company in America heretofore, with the exception of one which does not earn the interest on its bonds.

Taking then the true criterion, the average expense per unit of traffic, and not the deceptive one, the ratio of expenses to earnings, we will be able to see whether the improvements have effected any reduction in the cost of doing the company's work. As the reports do not give the passenger mileage, we can only make a statement for freight, but as there has been comparatively little change either in the bulk or the earnings of passenger traffic for nine years, this not so much to be regretted.

The expense per ton of freight hauled one mile on the Main Line of the Michigan Central Railroad for ten years have been:

1865.....	1.71 cts.	1870.....	1.22 cts.
1866.....	1.69 "	1871.....	1.11 "
1867.....	1.57 "	1872.....	1.07 "
1868.....	1.43 "	1873.....	1.00 "
1869.....	1.23 "	1874.....	0.85 "

Thus the cost of hauling freight has been reduced just one-half within ten years on this road, and the reduction since 1870, when the improvements were fairly begun, has been 39 per cent., and for the last year alone, when the improvements were so far completed as to have most of their effect, it was no less than 15 per cent. Being accompanied by a reduction of more than 17 per cent. in the average rate received, of course the net earnings do not show such saving. Doubtless the economy is not entirely due to the new improvements, as for two-thirds of the year the lower cost of labor and materials has had a considerable influence on the expenses. But the company's managers have certainly justified their action in making the expenditures for improvements and proved their statement that with such improvements the cost of transportation would be reduced. The cost per ton per mile for last year is less than has ever been reported before in this country, that on the Pennsylvania and branches, for 1873, which is nearest it, having been 0.857 cent. As the Michigan Central reports only for its Main Line, however, the comparison is not a fair one, and not improbably several roads besides the Pennsylvania would show expenses quite as low, or even lower, were the main-line traffic reported separately.

As our summary of the report shows, the increase in traffic has been really enormous, but has been almost entirely in a single branch, and that the least profitable—namely, through freight eastward, for which only 1.09 cents per ton per mile was received. There was a small increase in passenger traffic, which under the circumstances is very creditable, but in the branch of freight traffic named the increase in tonnage mileage has been nearly 50 per cent., and it amounted to no less than 70 per cent. of the entire freight traffic. Of the entire tonnage shipped two-thirds was received at Chicago, and as the Chicago shipments for the most part pass over the whole length of the road they gave doubtless a much larger proportion of the entire tonnage mileage.

As for the future of the road, it depends, as we have seen, quite as much on the rates which it will be able to charge as on the cost of transportation. The latter has been reduced to an extremely low figure, and with the rates of 1872-'73 would have left net \$2,256,500 from freight alone, or nearly \$850,000 more than the actual net earnings from freight. Very probably rates will not reach the figures of 1872-'73 again, but they may be higher than last year, and moreover the road may and probably will have a large increase in traffic, which it is now well prepared to handle with the help of some

additional rolling stock. An increase of 20 per cent. in the Main Line freight traffic without change from last year's rates or expenses would give net earnings enough to pay a ten per cent. dividend. Last year the increase in this traffic was nearly 30 per cent. A comparatively small increase in the average rate coupled with a small increase in traffic will make the net earnings sufficient to pay the old 10 per cent. dividends. That there will be an increase in traffic seems altogether probable; whether the rates will improve or no we dare not conjecture.

A MECHANICAL LABORATORY.

On another page we publish the correspondence between the Trustees of the Stevens Institute and Professor Thurston, from which it will be seen that the latter has been authorized to establish a Mechanical Laboratory as an adjunct to the very excellent institution with which he is connected. It is perhaps not necessary to say anything to show the advantages which might be gained from a laboratory of this kind, if properly conducted. This has been discussed in these pages and by several of the associations to which it has been presented, and so far as that aspect of the subject is concerned there is but one opinion, and that is decidedly in favor of such an institution. It is not necessary to say anything in favor of the abstract idea, but abstract ideas to be of any use in this material world must be put into a concrete form. It is not often necessary to advocate the claims of justice in the administration of the affairs of life, but if we want to make justice a power we must establish courts and appoint judges who will be incorruptible and who will neither "take bribes nor pervert judgment," and who withal will be wise to discern between right and wrong. Now it is unnecessary to say that we are all ignorant, that our knowledge is very limited and inaccurate, and that therefore a mechanical laboratory is needed to clear our mental vision, and explain things which are now inexplicable. We all know that; but the matter presents itself to us very much as the necessity for the administration of justice does: who is to be the judge? When there is a dispute about the possession of the fifteenth-mortgage bonds of the Walrusian Railroad, which are secured by the "commissions" received by its officers for the purchase of materials used in its construction and operation, we must have some one to investigate for us the claims of the original stockholders and of the fourteen other classes of bond-holders whose claims come in ahead of those based on the fifteenth-mortgage bonds. We must have a judge and perhaps a jury, who will patiently, and in the case of the former at least, intelligently listen to the evidence on all sides and instruct us regarding the law. Now it is just so about physical laws. If we want to know whether a given quality of bar iron is good material to make coupling links of, we must submit it to some one who knows the laws which govern the strength of materials and the distinctions, which only very recently are beginning to be made clear, regarding the qualities which enable iron to resist shocks and sudden strains and those which give it a high tensile strength alone. Not only that, it must be submitted to some one who has the requisite appliances to determine the degree in which it possesses each one of the qualities, which must be determined before an intelligent opinion can be formed. These qualities are not abstract quantities, but they must be determined by actual trial and observed by a person who is accurate, clear-sighted, and has that wonderful faculty so closely akin to genius which sees all that the phenomena under observation show, and only what they show. It is so of the testing of oil. At present we do not even know why oil lubricates, nor have we any very accurate means of determining which oil will lubricate the best, and which will not. Now, we need to have some one to determine for us the facts, and the reasons for them, and while he is investigating such subjects for us we do not want him to accept a present of a gold watch-chain from any one who has oils to sell, nor do we want his wife's heart to be gladdened nor his fireside cheered by music from a piano presented to him by the proprietor of a rolling mill. We do not say that a person who thus secured the requisites for his personal gratification might not record the indications of a testing machine accurately, nor distinguish the shimmer of a column of mercury in a thermometer clearly: all we say is that, owing to a mental or moral, if you choose, idiosyncrasy of our own, which we believe we share with a large part of the human race, if the person who was appointed to act in the capacity of a physical or mechanical judge for us were to allow himself to be made resplendent, or his family gladdened in the way indicated, it would prevent the collocation of currents of thought and feeling in us which result in believing that he saw what he said he did, and which perhaps he himself believed he saw.

Laying aside this irony (this is not a pun), the difficulty about establishing a laboratory of the kind that has been contemplated, and which was recognized during the discussion at the Master Mechanics' Convention and by nearly all who have talked about it, is that of putting the scheme into practical form. As one of the members of the organization very justly remarked during the discussion at

Chicago, the unstable character of the membership, and the peripatetic nature of the Association are very serious obstacles in the way of that society's assuming responsibility of such an establishment. It will be necessary at the very outset to hold property and assume its care, to appoint a person in charge, and to conduct investigations which, perhaps, only persons who have had a careful scientific training are competent to undertake. Happily for the whole scheme, all these difficulties are removed by the action of Professor Thurston and the Trustees of the Stevens Institute. They assume all the responsibility, and only need the aid of the different associations which are immediately interested. There will be no difficulty about the ownership of the property for such a laboratory if those who want investigations made and are willing to contribute money for that purpose will simply place the latter in the hands of the Stevens Institute on such terms and conditions as the donors may be disposed to make, and the trustees of that institution willing to accept. Ordinarily, we imagine, there would be little difficulty in arranging the conditions so as to be mutually satisfactory. Supposing, for example, that the Master Mechanics' Association should determine to have a comprehensive series of experiments made to determine what we need very much to know, that is, the strength of boiler plate, seams and braces, and that they should feel disposed to appropriate \$250 of their reserve fund for that purpose, making it a condition that the person in charge of the mechanical laboratory should co-operate with a committee to conduct such experiments. The appropriation would of course be insufficient, and it would therefore be necessary to appeal for aid to those interested in the subject. It might or it might not be difficult to secure the requisite money needed to make such investigations. We believe it would not be, but that is not important for our present illustration, as we only want to show that the action of the Stevens Institute now makes it possible to begin such investigations as the mechanical laboratory was intended for.

It is not pleasant to discuss, in this relation, the question whether the management of such an establishment would secure the confidence of those most interested in its work. Nevertheless, it is a very important matter, and the integrity of the management will be the first thing that persons will want to be satisfied about, and will be most generally questioned. The fact that it is in connection with an institution of learning, and under the control of its trustees and the management of its professors, will, we believe, secure for it at once the confidence of the public. No institution like that founded by Mr. Stevens could for a moment tolerate any mental or moral obliquity which "prepareth deceit." Even if the character of those who now occupy the chairs of the different professorships were not above question, the fact that no man in such a position could for a moment risk the chances of utter shipwreck to reputation which any suspicion of his perfect integrity would inevitably incur will more than anything else place it above suspicion.

Cheap Transportation.

The Northwest has never had its grain carried so cheaply as this summer. The decrease in the demand for iron ore and lumber has forced many vessels heretofore engaged in carrying these materials to compete for the grain traffic. Rates both by lake and canal are lower than at any time heretofore, except perhaps in dull times before the war, when not only was the currency gold but the gold dollar was worth considerably more than it is now. The *Buffalo Commercial Advertiser* gives the following comparison of average lake and canal rates during the month of June for fourteen years:

Year.	LAKE.		CANAL.	
	Wheat.	Corn.	Wheat.	Corn.
1860	10.0	9.0	14.5	12.5
1861	13.4	12.5	18.1	16.2
1862	6.6	6.0	13.6	11.6
1863	15.6	13.6	16.6	14.3
1864	6.5	3.7	13.2	11.2
1865	5.3	4.2	13.5	11.9
1866	6.6	6.5	13.7	11.7
1867	6.2	5.5	10.9	9.6
1868	5.7	5.3	10.1	9.1
1869	6.3	7.8	12.1	11.6
1870	6.5	5.8	10.6	9.6
1871	4.2	3.9	11.3	10.3

But rates have been materially lower since June, and for a week past 2½ per cent. per bushel has been the ruling quotation for corn from Chicago to Buffalo, and 8½ cents by canal from Buffalo to New York. Thus the cost of carriage on this great route is less than 11 cents per bushel, the distance being 1,425 miles. The average rate per ton per mile for this whole route is thus 0.275 per ton per mile. But the Lake rate is only about one-third of this amount, being 0.097 cent per ton per mile, or less than a tenth of a cent—not one-eighth of the average cost of transportation to the companies on the American railroads which carry the cheapest.

One of the causes for these excessively low lake rates, however, is said to be the competition of the railroads for the grain traffic in the absence of the usual amount of other and more profitable traffic; not that the railroads carry at rates as low as these, but at rates so low that the advantages of greater speed and the elimination of transfer expenses causes them to be preferred for a considerable portion of the traffic, though a small percentage of the whole. If these low rates continue they will be of great advantage in marketing the enormous grain crops of this season, and whether they continue or no will depend chiefly on the con-

tinuation of the present over-supply of vessels, and the over-supply will continue unless there is such a revival of business as will divert a considerable portion of them to other than grain traffic, or a very large increase in shipments. There is no doubt that the season is an unprofitable one to them, and if a vessel could be laid up and maintained without expense, a very large number of them would not run at current rates. These rates, though somewhat unfavorable to the roads from Chicago eastward, are advantageous to those which carry grain to Lake Michigan, it being their interest to have the expense from their eastern termini to the seaboard as low as possible. It is most unfavorable, however, to those Western railroads which cross Illinois south of Lake Michigan, and do not carry grain to any considerable extent for shipment by rail or canal, but only for through rail shipment. These reap their harvest when lake rates are high and a profitable through grain rate can be made from Western points which will be less or at least no higher than the rail rate to Chicago plus the water rate thence. Such roads as the Chicago & Alton and the Illinois Central gain now, while such as the Toledo, Wabash & Western and the Indianapolis, Bloomington & Western lose.

The Recent Defaults.

We congratulated the railroad world about a month ago on the fact that so few new defaults were made on the 1st of July, when an enormous number of companies have interest to pay, and when we had very much feared to hear of a considerable number of new failures, including some of roads which are older and stronger than most of those which had failed during the previous year. Then, writing on the first day of the month, the defaults which had come to our knowledge were those of the Atlantic & Great Western in its first-mortgage bonds, the Indianapolis, Bloomington & Western, and the California Pacific Extension. Since that time, however, information has reached us of several other defaults, and the July list now stands as follows:

Atlantic & Great Western:	
First-mortgage gold 7s.	\$14,414,977.50
California Pacific Extension:	
First-mortgage gold 7s.	3,600,000.00
Cleveland, Mount Vernon & Delaware:	
First-mortgage gold 7s.	1,300,000.00
Second-mortgage gold 7s.	1,000,000.00
Indianapolis, Bloomington & Western:	
Extension second-mortgage gold 7s.	5,500,000.00
Second-mortgage 8s.	1,500,000.00
Lake Shore & Tuscarawas Valley:	
First-mortgage 7s.	2,000,000.00
Stockton & Copperopolis:	
First-mortgage gold 8s.	1,000,000.00
The annual interest on these issues amounts to \$1,890,048 gold and \$260,000 currency, equivalent with gold at 110 to \$2,328,053 in currency, one half of which amount is now overdue from these roads.	
In August comparatively few companies have interest due, but the number of defaults is yet considerable, as appears from this list.	
Columbus, Chicago & Indiana Central:	
Second-mortgage 7s.	\$3,747,000
International:	
Convertible 8s.	3,150,000
Peoria & Rock Island:	
First-mortgage 7s.	1,500,000
Total.	\$8,397,000

The annual interest on these issues is \$613,290 currency, and the amount now overdue is \$309,645.

Of these companies, the Atlantic & Great Western is well known. It has an extravagantly large debt (several classes of bonds on which interest has not been paid heretofore), a very good traffic which has to be carried at low rates by reason of the competition of shorter lines, and last year the rates have been so low as to absorb nearly all the earnings. It is guaranteed 30 per cent. of its gross earnings by the recent rental to the Erie, and ordinarily these are likely to be enough to cover the interest on these bonds.

The Cleveland, Mount Vernon & Delaware Company, whose road is now known as the Cleveland, Mount Vernon & Columbus, has two issues of first-mortgage 7 per cent. gold bonds, \$1,300,000 on the 100 miles from Hudson to Mount Vernon, and \$1,000,000 on the recently completed section of 45 miles from Mount Vernon to Columbus. The capital stock outstanding is reported as \$1,751,450.

The Pennsylvania Railroad Company at the date of its last report owned \$1,100,000 of its common and \$290,100 of its preferred stock, or more than four-fifths of the whole. During the year 1873 its net earnings were \$133,107, of which \$20,000 was due for rent of the Massillon Branch, besides the \$161,000 of interest. The report for 1873 gives after the net earnings receipts "from other sources" amounting to \$88,827, which covered the interest and left a surplus of \$41,000. Whether this was borrowed money or no, we have no means of knowing.

Very little seems to be known of the California Pacific Extension bonds, which were chiefly based, so far as we can learn, on a road which never was built.

The Indianapolis, Bloomington & Western was one of the most successful of the new roads two years ago, when the extraordinarily high lake rates drove traffic to the east-and-west railroads south of Chicago. But then it constructed a long branch line, called the "Western Extension," through a country already crowded with roads. Its earnings per mile for the first half of 1874 were 45 per cent. less than for the same period in 1872.

The Lake Shore & Tuscarawas Valley is a new road, constructed mainly for coal and iron traffic. The depression in iron industries having enormously decreased that traffic, the road's earnings are now very light. It is not heavily in debt, and with average activity in iron manufactures ought to earn its interest charges easily.

The Stockton & Copperopolis is a line constructed from the San Joaquin Valley eastward into the foot hills of the Sierra Nevada, and is hardly calculated to carry much traffic, the

country on its line not affording much to carry. The reports show that it has never earned its working expenses. The road has been nearly from the beginning under the control of the owners of the Central Pacific, who presumably have advanced the money for the interest heretofore, but have now got tired of it.

The Columbus, Chicago & Indiana Central Company is the product of the consolidation of half-a-dozen companies, whose various issues of bonds number no less than seventeen, amounting to \$23,555,174.25. Of this amount \$15,344,750 is in first-mortgage bonds, bearing 7 per cent. interest. By the terms of the lease to the Pittsburgh, Cincinnati & St. Louis Company, the lessee guarantees the payment of the interest of \$15,000,000 of the first-mortgage bonds and on \$221,000 of an issue of Columbus & Indianapolis Central second-mortgage 7s. This is the minimum rental, and the lessee is to pay in lieu of it 30 per cent. of the gross earnings of the property if they exceed this interest. In fact this part of the gross earnings has never equaled the guaranteed interest. Besides the guaranteed bonds, there are three issues, amounting to \$4,757,900, of second-mortgage bonds. The last report of the Pennsylvania Railroad Company shows it to be the owner of \$1,258,000 of what is described as "second-mortgage \$5,000,000 loan," and of \$3,504,000 of "second-mortgage \$10,000,000 loan."

Besides these bonds, the company has outstanding \$2,554,000 of convertible income 7s, and \$74,024 of income bonds. These and \$3,747,000 of the second-mortgage bonds have coupons due in August and February, and it is on the latter, we understand, that the default is made. It appears that heretofore the interests on all the bonds as well as those guaranteed have been paid by the lessee. We do not know how it has been secured for these advances, which amounted last year to about \$377,000.

The International of Texas had a contract with the State by which it was to receive the State's bonds at the rate of \$10,000 per mile of road, under which contract \$2,050,000 is now due. The State officials refused to deliver the bonds, however, claiming that the grant was unconstitutional. On appeal to the Supreme Court of the State, it decided that it had no power to issue an order to compel an executive officer to obey the law, and declined to consider the constitutionality of the law. The Legislature will be called upon to make some new arrangement, with a reasonable prospect that it will do so. The road in time ought to have a large traffic, but so far the country on its line is thinly settled.

The Peoria & Rock Island is a pretty well placed road, though it fares best when lake rates are high. It has been chiefly a feeder of the Indianapolis, Bloomington & Western, and would doubtless earn more if the country through which it passes were not so well provided with railroads.

The Size of Journals.

A correspondent whose letter we publish on another page comments on our article on "Friction and Lubrication," published in the *GAZETTE* of July 18. He asks, "by what process of calculation do you establish the formula given for the weight allowable on each square inch of journal?" Our reply is that the formula is not based on calculation but on experiment. It rests simply on the fact that some one has found that, at the speeds given, if a greater pressure per square inch rested on the journal than that given the lubricant was expelled. Now these limits vary with the conditions of the experiment. With the best lubricants, or with the most improved oils, the utmost care, or better material or adjustment of the bearings, or with better workmanship, doubtless more weight per square inch could safely be placed on the journals. Thus the pressure on the main crank-pins of locomotives is much greater than we ever think of putting on the bearings of freight cars, but on the locomotive the most effective appliances are attached to the connecting-rods to keep them constantly oiled with the best lubricant, and they are under the care of a thoroughly trained man, whose duty it is at very short intervals to examine the bearings to see if they are properly oiled and are running cool. Such attention is impossible, therefore we must make the bearings larger, so as to reduce the risk of heating. Now the fact of the frequency with which "hot boxes" are heard from indicates, we think, that the risk of heating needs to be still further reduced by enlarging the journals still more.

The rule which we gave was intended only as an illustration of the necessity of enlarging the journals as the speed is increased, and we thought that we guarded against its being accepted literally when we added that "there should in all cases be a liberal allowance on the side of safety."

As the subject of friction has been recently treated very fully in the "Catechism of the Locomotive" published in the *RAILROAD GAZETTE* of August 1, we will not go over the same ground here again, except to say that the relative merits of the "standard" and a smaller axle rest, we believe, entirely on the fact, so far as the present discussion is concerned, that with the former the oil is less liable to be expelled, and therefore the journal is more certain to be well lubricated in ordinary use than a smaller axle, and the co-efficient of friction will therefore be lower with the big axle than with the little one. Now this is a matter of fact and not a theory, and capable of practical test, and we know of no one more capable of making this test than our correspondent. We will suggest the following method: Select a grade of 40 or 50 feet per mile, with a level and straight track at the foot of the grade. Take 20 loaded cars with the big axles, and 20 with little ones, out of the ordinary trains and in the usual condition of lubrication that they are in under ordinary circumstances, or when they reach say Chicago or Albany. Now take each one of the cars and place it at a certain point on the grade and let it run down as far as it will on the level and straight part of the track from the momentum imparted by its own gravity, and then measure the distance which

it has run. Try each car in this way, and record and compare the results. It would also be well to weigh each car, so as to be able to compare the results in reference to their weight. Of course the cars, excepting axles, should be as nearly alike as possible; that is the wheels should be of the same diameter and they should all have run about the same time. We hope some of our readers will make such an experiment and give us a report of it. We want to impress on those who make it, however, that the cars should not be specially oiled for the occasion, but should be in the condition in which they are found on the road, after being in use for some time.

We think we were correct in stating that the superficial area of a journal is the measure of its capacity to dissipate heat. The heat is generated at the rubbing surface of the journal. From there it is conducted to the objects by which it is surrounded, just as the heat inside a locomotive boiler tube is conducted from its surface to the water around it. This conducting capacity is due to the surface in both cases and not to the cubical dimensions any more in the case of the journal than in that of the tube. It is probable that more heat in proportion to its size is conducted by the solid axle to the wheels than is conveyed to the sectional area of the axle. The heat in leaving the axle is radiated from the boxes and wheels, or conveyed away by currents of air.

With reference to "going back on the big journal people" we have little to say. If we find that we have been mistaken in thinking that there is more certainty of good lubrication with the "standard journal" than with one of a smaller size, or if we can be convinced that a big axle is not stronger than a little one, we will try and be frank enough to admit our mistake, but until then we hope those of our readers who have better opportunities of making experiments which "give us more light" will do so. The mistake which has been made, we think, is that the "standard" is still too small, and we believe that a journal 4 x 8 inches would give more satisfactory results in every way, but we have acted on the advice of a distinguished English statesman, who said that it is not advisable always to try to do the best thing that might be done, but the best thing that can be done.

Record of New Railroad Construction.

This number of the RAILROAD GAZETTE has information of the laying of track on new railroads as follows:

Easton & Amboy.—Extended 5 miles to New Brooklyn, N. J., Harrisburg & Potomac.—Completed from a junction with the Dillsburg & Mechanicsburg road, about six miles south of Mechanicsburg, Pa., westward 12 miles to Barnitz Mills. *Painesville & Youngstown.*—Extended from Middlefield southeastward 25 miles to Niles, O., (of 3 feet gauge). *Des Moines & Minnesota.*—Extended northward 20 miles to Ames, Iowa (of 3 feet gauge). *Kansas City, Independence & Lexington.*—Completed from Independence, Mo., westward 10 miles to Kansas City (of 3 feet gauge). *Galveston, Harrisburg & San Antonio.*—Extended from Waelder west 12 miles to Harwood, Tex. *Denver, South Park & Pacific.*—Completed from Denver southwestward 15 miles to Morristown, Col. (of 3 feet gauge). *Denver & Rio Grande.*—The Canon City branch has been completed from Labran, Col., to Canon City, 8 miles (of 3 feet gauge). *Southern Pacific.*—Extended southward 7 miles to Kern River, Cal.

This is a total of 112 miles of new railroad, 78 miles being of 3 feet gauge, making a total of 839 miles of railroad completed in the United States in 1874 against 1,872 completed during the same time in 1873, and 3,237 in 1872.

THE SARATOGA CONVENTION has been much talked of during the past week, but its chief claim to importance seems to consist in the names of its callers, who are understood to be Messrs. Thomas A. Scott, Hugh S. Jewett and Wm. H. Vanderbilt. But that a conference should be called for by three such men, managing three great lines between the East and the West, is a significant fact, though significant of what we will not venture to say. Usually such a step signifies that the trunk lines are suffering and are willing to agree not to hurt each other and try to be in some degree mutually helpful. But of course it might mean that the railroad managers have had a change of heart and have called an experience meeting that they might declare that they would never, never quarrel any more, but live in brotherly love all the days of their lives.

So far as has come to light, the action of the conference was with regard to maintaining rates, and to establishing some sort of an authority to decide what are and what are not legitimate practices in competing for freight. Umpires are proposed at the principal shipping points to hear testimony and settle disputes, and prevent as far as possible "cut-throat competition" by which our companies mutually bleed each other at short intervals.

The Baltimore & Ohio was not represented at this conference, which lessens the probability of the success of its measures.

THE RELATIVE IMPORTANCE OF EXPORTS, considered as subjects for transportation, we have studied on the bases of the exports from the port of New York for the first seven months of 1874. The difficulty in the way of a comparison is the variety of units of traffic, flour in barrels, grain in bushels, cotton in bales, petroleum in gallons, etc. Taking the principal articles and reducing them to tons, we reach the following results:

	Tons.	Ratio to Total.
Breadstuffs.....	1,192,900	70.4
Petroleum.....	222,987	13.2
Pork products.....	127,328	7.5
Cotton.....	63,568	3.7
Cattle products.....	48,165	2.8
Naval stores.....	21,886	1.4
Tobacco.....	17,030	1.0
Total.....	1,693,862	100

Of course this would not apply to the exports of the whole

country, in which cotton would hold a much higher place, still the fact that more than seven-tenths of the tonnage of all these leading export staples is composed of breadstuffs is a very striking one, as is this other, not generally understood, we presume, that petroleum is next in importance.

It is easy, however, to exaggerate the importance of the export traffic, at least to carriers. It is a trifle compared to the internal commerce in articles which never cross the sea. Coal, for instance, of which we export very little, exceeds in tonnage on a single railroad line the entire exports of the port of New York.

NEW PUBLICATIONS.

Spon's Dictionary of Engineering. Edited by Byrne and Spon. London, 1869-1874. pp. 3,131.

The publishers may well feel proud of the conclusion of this valuable work, and we believe that we but repeat the conclusions of all who have examined it in saying that it is the best technical dictionary that has yet appeared. One cannot turn to the pages of any of the divisions without seeing much that will be of value to professional men. The work is particularly rich in articles that will prove interesting to those who are engaged in railroad construction, and the building and management of railroad rolling stock. We had intended to mention the principal articles on subjects of this nature, but a glance at the formidable list contained in the index convinces us that we must be content with but a partial review. One very useful feature in this dictionary consists in giving the French, German, Italian and Spanish words for the various terms as they occur. The fact that it unites the classification ordinarily adopted in a dictionary with the fullness of treatment usual in a cyclopedia is deserving of praise. The editors seem to have employed great discrimination in the selection of their matter, and as a result we have, besides original essays by well-known engineers, a good resume of the most valuable articles that have appeared in scientific periodicals for the last few years. Under the head of "Dynamometer Car" is given the complete report of M. M. Vuillemin, Guebbard and Dieudonne of their experiments on the resistance of railroad trains, and the power of locomotive engines. These were among the most complete experiments ever made on the subject, and we commend the perusal of this report to railroad officials. The article on "Bridges," covering more than 200 pages, besides detailing the general principles of construction, gives particulars of the most noted examples, both in this country and in Europe. Indeed, in most cases in which the subject warrants it, an extensive treatise, embodying the most important facts, has been given. A partial list of the subjects of interest to railroad men will show articles on "Adhesion," "Alloys," "Aqueducts," "Arches," "Axles," "Ballast," "Blasting," "Boilers," "Bolts and Nuts," "Boring," "Brakes," "Brickwork," "Cements," "Concrete," "Corrosion," "Curves and Gradients," "Dams," "Docks," "Drainage," "Dry Rot," and the like; for we are warned by the limits of our space to cease this catalogue of good things. About 3,500 subjects are presented in the index, of which some 900 refer directly to matters connected with railroad engineering and management. Our readers will do well to procure the work and examine it for themselves. It will be a valuable addition to any professional library.

General Railroad News.

ELECTIONS AND APPOINTMENTS.

—The Lake Simcoe Junction Railway Company was organized at Toronto, Ont., recently by the election of the following directors: James Anderson, J. N. Blake, J. R. Boucher, N. Graham, R. McCormick, Robert Royland, Edmund Shuttlesworth, W. Summerfelt. The board elected J. N. Blake President and R. McCormick Vice-President.

—Mr. John W. Uine has been appointed Superintendent of the Des Moines & Minnesota Railroad.

—The officers of the New Orleans, St. Louis & Chicago Railroad Company (formed by the consolidation of the Mississippi Central and New Orleans, Jackson & Great Northern) are as follows: H. S. McComb, President, Wilmington, Del.; S. H. Edgar, Vice-President, New Orleans; A. M. West, Second Vice-President, Mississippi; A. J. McConico, Auditor, New Orleans; R. S. Charles, Treasurer, New Orleans; William Calhoun, Secretary, New York; E. D. Frost, General Manager, New Orleans; S. E. Carey, General Passenger and Ticket Agent, New Orleans; D. B. Morey, General Freight Agent, New Orleans; W. P. McKinley, Superintendent Louisiana Division, New Orleans; R. Colquhoun, Superintendent Mississippi Division, Water Valley, Miss.; John G. Mann, Superintendent Tennessee & Kentucky Division, Jackson, Tenn.; J. D. Billings, Master Car-Builder, McComb, Miss.; D. G. Morey, Baggage and Claim Agent, New Orleans; Wm. Carson, General Eastern Agent, No. 385 Broadway, New York.

—Mr. William A. Brown, late Superintendent of the Bedford Division, has been appointed Chief Engineer of Maintenance of Way of the Pennsylvania Railroad, in place of Theodore I. Heizman, who has resigned. Mr. Sutherland M. Prevost replaces Mr. Brown as Superintendent of the Bedford Division.

—The following changes have been made among the officers of the Pennsylvania Company: Mr. John N. McCullough has resigned his position as General Manager, and will hereafter give his whole time to his duties as First Vice-President. Mr. J. D. Layng, late Assistant General Manager, is appointed General Manager, with office at Pittsburgh. Mr. George Webb, late General Superintendent of the Pittsburgh, Cincinnati & St. Louis, is appointed Assistant General Manager, with office at Pittsburgh. He will have charge of the Eastern Division of the Pittsburgh, Fort Wayne & Chicago, and the various lines attached thereto.

—The following appointments of officers of the Pittsburgh, Cincinnati & St. Louis Railway took effect August 1: Mr. D. W. Caldwell, late Superintendent of the Columbus, Chicago & Indiana Central, is appointed General Manager, in place of Mr. Hugh J. Jewett, who has resigned to accept the Presidency of the Erie Railway Company. In addition to the Pittsburgh, Cincinnati & St. Louis and its leased lines, he will have charge of the Jeffersonville, Madison & Indianapolis and the Indianapolis & Vincennes roads. His office will be at Columbus, O. Mr. S. M. Felton, Jr., is appointed General Superintendent, in place of Mr. George Webb, who has been transferred to the Pennsylvania Company. Mr. Felton's office is at Pittsburgh, Pa.

—Mr. J. F. Leavitt has been appointed General Ticket Agent of the European & North American Railroad.

—Mr. W. H. Buckingham has been appointed Auditor of the Terre Haute & Indianapolis Railroad Company, in place of M. S. Durham, resigned.

—Mr. Eugene Lowe has been appointed Cashier of the Wisconsin Central Railroad, in place of Henry A. Phillips.

—At the annual meeting of the Addison Railroad Company, July 21, the following directors were chosen: W. T. Foote, Port Henry, N. Y.; Gasca Rich, Shoreham, Vt.; Lawrence Barnes, Burlington, Vt.; John B. Page, Rutland, Vt.; E. A. Birchard, Brandon, Vt.

—At the annual meeting of the Rutland Railroad Company in Rutland, Vt., July 28, the following directors were elected, the number having been increased to nine by vote of the stockholders: Lawrence Barnes, James W. Hickok, Burlington, Vt.; John B. Page, William Schier, Rutland, Vt.; Edwin A. Birchard, Brandon, Vt.; James H. Williams, Bellows Falls, Vt.; Jacob Edwards, Peter Butler, James S. Whitney, Boston. The new directors are Messrs. Whitney and Schier. The board re-elected John B. Page, President; J. M. Haven, Rutland, Vt., Treasurer; B. B. Smalley, Burlington, Vt., Clerk.

—Mr. Charles Rockwell has been appointed General Freight Agent of the New York, New Haven & Hartford Railroad, in place of George Hamilton Forbes, who has resigned. Mr. Rockwell has been for some time the company's agent in New York. Mr. Peter F. Furlong, of Hartford, has been appointed Assistant General Freight Agent.

—Mr. James McDaniel has been chosen President of the Dayton & Union Railroad Company, and Mr. C. C. Dale has been appointed Superintendent of the road.

—Captain Bowen, who is an officer of the Old Dominion Steamship Company, has been chosen a director of the Junction & Breakwater Railroad Company, which the former now controls.

—Mr. David M. Edgerton has been chosen Secretary of the Kansas Pacific Railway Company, in place of Mr. Charles B. Lamborn, who has resigned.

—The board of directors of the Erie Railway company has chosen the following Committees: Executive Committee, John A. C. Gray, F. Schuchardt, S. L. M. Barlow, H. Ramsdell; Finance Committee, H. G. Stebbins, M. O. Roberts, L. H. Meyer.

—Mr. W. H. D. Cochrane, General Freight Agent, has been appointed Acting Superintendent of the Nashua, Acton & Boston Railroad.

—Gen. Braxton Bragg has been appointed Chief Engineer of the Gulf, Colorado & Santa Fe Railroad, and will, for the present, have his headquarters at Galveston, Tex. He proposes to have a corps of 100 men in the field shortly.

—Mr. J. Frederick Maynard, of Utica, N. Y., has been appointed General Superintendent of the Utica & Black River Railroad, in place of T. W. Spencer, resigned. Mr. Maynard, though a young man, has been long in the service of the road and for some time past has been General Ticket Agent.

—Mr. A. B. Chamberlain, of Elmira, N. Y., has been appointed Assistant Auditor of the Erie Railway, with office in New York. He has been for a long time in the service of the company in various positions.

—Mr. M. Stanton, late Superintendent of the South & North Alabama, has been appointed General Superintendent of the Selma, Rome & Dalton Railroad, in place of John B. Peck, resigned.

—The St. Louis Railroad Register says:

"Mr. A. E. Touzalin, formerly connected with the Burlington & Missouri River Land Department in Burlington, Iowa, and subsequently General Passenger and Ticket Agent of the Atchison, Topeka & Santa Fe Railroad, has returned to Burlington and resumed duty once more in the Land Department—this time as Land Commissioner."

—Colonel Farquhar, who has charge of the Government surveys of the Minnesota, St. Croix and Red River surveys, has appointed Mr. J. S. Sewall Assistant in charge of the St. Croix survey; Mr. H. H. Douglas Assistant in charge of the Minnesota River survey, and Mr. L. Y. Schermerhorn, Assistant in charge of the surveys of the Red River of the North.

OLD AND NEW ROADS.

Rutland.

The resolutions adopted by the stockholders at the meeting in Rutland, July 30, authorize the directors to reduce the yearly rental to be paid by the Central Vermont Company \$100,000, and also to raise the rent of the Addison road by the amount of the dividends on the Addison stock owned by the Rutland Company. The total reduction will be about \$110,000. Under the lease the rental for 1874 would be \$465,000; for 1875, \$519,000; for 1876, \$548,000. The contract is not to be altered in any other respect than as to the amount of rent. The net earnings last year were \$310,000, so that the lessees lost a considerable sum in operating the road.

A resolution to appropriate \$50,000 a year for five years to aid in the building of the Caughnawaga Canal was voted down.

Chicago & Alton.

The trustees of the preferred first mortgage give notice that according to the terms of the mortgage they have designated by lot 32 bonds, principal and accrued interest of which will be paid on presentation to S. J. Tilden, No. 12 Wall street, or L. H. Meyer, No. 21 Nassau street, New York. Interest on these bonds will cease November 1. The numbers of the bonds drawn are: 1, 99, 52, 97, 102, 109, 110, 116, 145, 171, 217, 226, 291, 297, 306, 316, 325, 333, 338, 386, 405, 425, 448, 452, 469, 471, 479, 526, 533, 577, 578, 594, all of \$1,000 each.

New York, New Haven & Hartford.

The slips and ferry bridges at the southern end of the Harlem River Branch are completed. They are intended for the freight boats which are to run in connection with the road. Two steam derricks are being erected to handle coal and other heavy freight. It is intended to transfer cars loaded with fruit and other perishable freight from Jersey City to this point on ferry boats.

Selinsgrove & North Branch.

Twenty miles of the grading and masonry of this road, beginning at Port Trevorton, Pa., has been finished, and the work is being pushed forward. The road is to run from Port Trevorton northward to Selinsgrove, and thence southwest to the Pennsylvania at Mifflintown, a distance of about 40 miles. The grading of this section is to be finished this year. In September surveys are to be begun for an extension of about 80 miles, from Mifflintown, south by west, to the Baltimore & Ohio at Hancock, Md., and it is also proposed to build a branch of 10 miles to the East Broad Top coal fields. The grading will be paid for by stock subscriptions, and bonds to the amount of \$15,000 per mile will be issued to pay for rails and equipments. The road opens up a country rich in iron ore and lumber.

New York Central & Hudson River.

The Schenectady (N. Y.) Union says that for some time past much trouble has been caused by a lifting up of the track near Hoffman's, 26 miles west of Albany. For weeks about 100 feet of the road has been gradually rising, at times making the passage of trains more or less difficult. The soil has been

taken off, at various times, as fast as it rose, in order to keep the track down where it should be, but still men are kept at the place night to watch it. The occurrence is a curious one. It is difficult enough to account for land sinking, but to find a reason for its lifting itself up is still more so. It is said, however, that the hard-pan nearest the surface is underlain by quicksand to an unknown depth, and that unusual under currents of water from the highlands above, flowing down upon the quicksand element, and being unable to escape by the ordinary channels, creates such a pressure that the hard-pan above is forced up, carrying the track with it. The remedy that is being tried is to dig a deep ditch on the upper side of the road, with a view to catching the water from the hill, and conducting it off in under-ground pipes, so that it will not reach the quicksand under the road bed.

The new third and fourth tracks are laid but not yet ballasted from Oneida to Verona, four miles. From Verona to Rome, 8½ miles, the ballasting is partly done. The tracks are ready for use for some miles east from Rome, and are all laid from Rome to Utica, 14 miles.

Freight Rates Westward.

A new schedule of rates on freight bound West has been arranged by the trunk lines, the following being the rates per 100 pounds from New York to some of the principal western points:

	First class, cents.	Second class, cents.	Third class, cents.	Fourth class, cents.	Fifth class, cents.
Chicago.....	75	70	60	45	35
St. Louis.....	97	91	79	61	49
Cincinnati.....	70	64	55	41	32
Omaha.....	180	150	130	95	80
New Orleans.....	144	135	118	90	71

This is a reduction of from 20 to 25 per cent. on the published rates to Chicago and St. Louis, while to Omaha there is a small increase in first-class and a small reduction on fourth and fifth-class freight. The old rates to Chicago were: First class, 100 cents; second class, 90; third, 75; fourth, 60; fifth, 45.

Boston & Albany.

Plans have been adopted for a new depot, to cost \$500,000, at Springfield, Mass. The building of this depot with the required alteration in the tracks and the new engine-house will take some three years. Meantime the present depot is to be much improved, though in a temporary and provisional manner.

Illinois & St. Louis Bridge.

Four locomotives designed for service across the bridge and through the tunnel have been completed and are on their way to St. Louis. They are intended to burn coke and were built at the Baldwin Works in Philadelphia.

Utica & Black River.

Some of the stockholders of the Carthage, Watertown & Sackett's Harbor Company have raised a question as to the validity of the lease of that road to the Utica & Black River, and it is probable that a suit may be begun to test the question.

The Utica (N. Y.) Herald says: "The demand of the Utica & Black River Railroad Company, that \$10,000 of the mortgage bonds of the Carthage, Watertown & Sackett's Harbor Railroad be given before they accept the road from Watertown to Sackett's Harbor, has been acceded to by a majority of two. Mr. Flower, the contractor, who had not been paid, served an injunction on the President of the company, enjoining him from disposing of the \$9,000 now in the possession of the company."

Pacific, of Missouri.

A new track or cut-off is to be built from Wyandotte, Kan., just west of Kansas City, to a point near Quindaro, some six miles distant. The new track will be nearly straight, and as soon as it is finished the old crooked track which follows nearly the course of the Missouri River will be abandoned. The new line has been located and proceedings have been commenced to condemn the right of way.

Southwestern, of Canada.

This company proposes building a railroad from Windsor, Ont., opposite Detroit, southwest to Two Creeks on Lake Erie, a distance of about 40 miles. It is proposed to improve the harbor at Two Creeks and make it a first class port.

The Wisconsin Railroad Law.

The motion for an injunction to restrain the Chicago & Northwestern and Milwaukee & St. Paul companies from violating the law came up in the Wisconsin Supreme Court August 4. The day was taken up with an argument as to whether the complaint should be set aside on technical grounds.

The Postal Car Question.

Nothing definite has been done in the controversy between the Post Office Department and the Philadelphia, Wilmington & Baltimore Company. Numerous letters and telegrams have passed between the parties, but the postal cars are still running over the road down to the time of writing. Mr. Hinkley, President of the railroad company, having repeatedly notified the Post Office Department that if the cars continued to be sent he should take it as an acceptance of his demand for an increase of 60 per cent. in the compensation, and the Department having also notified Mr. Hinkley that no more compensation would be allowed than is provided by law. Mr. Hinkley places great stress on the fact that the contractor for carrying the mail over the Connecting Railroad, from Mantua to Frankford, is paid at a very much higher rate than his company, for the same service. In case the Philadelphia, Wilmington & Baltimore Company does finally refuse to haul the cars, it is said that they will be sent around by way of York and the Northern Central to Baltimore.

Atlanta & Richmond Air Line.

A meeting of the first-mortgage bondholders was to be held at the office of Lancaster, Brown & Co., New York, August 7, to ratify an agreement for the settlement of the claims of the bondholders, without resorting to a foreclosure. The agreement to be voted on is endorsed by the committee.

Baltimore & Ohio.

This company purchased some time since the old Museum property on the corner of Baltimore and Calvert streets, in Baltimore, for \$225,000. Plans have now been completed for a fine building for the general offices of the company, and work on it will probably be begun soon. The building is to have a frontage of 60 feet on Baltimore and 102 feet on Calvert street, and will be five stories high, and the exterior will be of granite and Maryland marble.

Southern Pacific, of California.

The track on the extension southeast of the main line has been laid to Kern River, three miles from Bakersfield, Cal., and seven miles beyond the last point reported. The bridge over Kern River will, it is expected, take about a month to build. Bakersfield is to be the southern terminus for this year.

Illinois Central.

This company is now selling 1,000 mile tickets, good over all its lines in Illinois and Iowa.

The Houston Ship Channel.

Mr. Charles Morgan, the steamship owner, has closed an

agreement with the Texas Ship Channel Company to clear out a channel in the Bayou to Constitution Bend, four miles from Houston, Tex. The channel is to be nine feet deep and 150 feet wide. Five dredge boats, three of them owned by Mr. Morgan, will be set to work at once. As soon as the channel is completed Mr. Morgan's steamers will run to that point instead of stopping at Galveston. A railroad connection will be made with the lines entering Houston. Mr. Morgan is said to have made this arrangement in consequence of the high rates of wharfage charged by the Galveston Wharf Company, which has a monopoly of the dock accommodations of that port.

Iowa Railroads and the Liquor Traffic.

In consequence of the existence of a law prescribing a penalty for the delivery of liquor by any common carrier to any person not authorized to sell the same, nearly all the lines entering Iowa from the east have instructed their agents to refuse all shipments of liquor to persons in Iowa, unless a proper and legal certificate is exhibited, showing that the consignee is duly authorized to sell liquor under the law of the State.

Indianapolis, Cincinnati & Lafayette.

Two through lines have been organized, one from Cincinnati to Kansas City, Mo., by this road, the Indianapolis, Bloomington & Western, Toledo, Wabash & Western and Hannibal & St. Joseph; the other from Cincinnati to Omaha by this road, the Indianapolis, Bloomington & Western and Chicago, Burlington & Quincy. Through coaches are to be run from Cincinnati to both Kansas City and Omaha.

Burlington & Southwestern.

Capt. E. B. Ward, President of the company and lessee of the road, has filed a bill in equity for the purpose of enjoining the bondholders from foreclosing the mortgage and to compel a performance of the agreement made when the road was leased. Captain Ward claims that he has under the lease expended over \$350,000 for the benefit of the road, and that the company and the bondholders now refuse to carry out their part of the contract and furnish means to complete the road and pay its debts. Moreover, the bondholders propose to foreclose the mortgage and cut him off from all redress.

Minnesota & Northwestern.

It is stated that the grading and trestle work from Mankato, Minn., to the Sauer bridge, five miles, is ready for the iron and that 12 miles of iron has been received. Two engines have also been purchased for the road.

Memphis, El Paso & Pacific.

French papers say that certain bondholders brought an action some time ago before the civil tribunal of the Seine in order that the court might fix the amount of damages and interest due them. The tribunal has suspended its judgment for one year, a delay which it judges necessary for the due execution of the proposed convention, for the exchange of mortgage bonds against 700,000 acres of land in Texas. All action of a litigious character will, therefore, be suspended by the French law courts until June, 1875.

Grand Trunk.

Arrangements are being made for the change of gauge from 5 feet 6 inches to 4 feet 8½ inches, on the lines east of Montreal. This change will probably be made in September, and all the company's lines will then be of the standard gauge. It was at first proposed to keep the Quebec and Rivière du Loup divisions of the old gauge, but it was finally decided to change them also. The traffic on those sections is light, and according to the President of the company has never paid operating expenses.

Mr. Potter was to leave England August 1, with Mr. Seargeant, who with Mr. Hickson is to constitute the voting portion of the Executive Council which is to have the management of the road. There are to be four other members, Mr. Hannaford, Mr. Spicer, Mr. Stephenson and Mr. Wallis, but they will have only the right to speak and not that of voting. In order to prevent a tie, Mr. Hickson is to have two votes and Mr. Seargeant only one.

A Meeting of Railroad Managers.

A conference of railroad managers was held last week at Saratoga, N. Y. The meeting was at the invitation of Mr. Vanderbilt, and there were present besides that gentleman Col. Scott of the Pennsylvania, Mr. Jewett of the Erie, Gen. Devereux of the Atlantic & Great Western and Cleveland, Columbus, Cincinnati & Indianapolis; Mr. Joy of the Michigan Central, Mr. Cox of the Toledo, Wabash & Western, and Mr. Tracy of the Rock Island. The proceedings, of course, were not public; but it was understood that the main object was to secure uniformity in rates, prevent under-cutting and to provide for greater harmony in methods of doing business. The Baltimore & Ohio was not represented.

Dividends.

Dividends have been declared by the following companies: Terre Haute & Indianapolis, 5 per cent., semi-annual, payable August 10. Troy & Boston, 2 per cent., semi-annual. Rutland, 3¼ per cent., semi-annual on the preferred stock, payable in scrip August 17. Naugatuck, 5 per cent., semi-annual, payable August 1. Connecticut & Passumpsic Rivers, 3 per cent., semi-annual, payable August 1.

New Orleans, St. Louis & Chicago.

This road has been divided for operating purposes into three divisions. The Louisiana Division is the old New Orleans, Jackson & Great Northern road, from New Orleans to Canton, Miss., 206 miles. The Mississippi Division extends from Canton to Jackson, Tenn., 235 miles. The Tennessee & Kentucky Division is the new part of the road, from Jackson to Fillmore, Ky. (opposite Cairo), 107 miles.

Texas Midland, Gulf & New Orleans.

The eastern terminus of this road is to be at or near the mouth of the Sabine, and it is to run thence in a general northwest direction through Central Texas to a point not yet decided on. It will be some 300 miles long.

Kansas City, St. Joseph & Council Bluffs.

An injunction has been served on this company to prevent its trains from crossing the bridge over the Missouri from Council Bluffs to Omaha.

North Pennsylvania.

It is stated that the line which is to connect with the Delaware River & Bound Brook, and with that road and the New Jersey Central make a new line from Philadelphia to New York, is finally located. It leaves the main line of the North Pennsylvania at Jenkintown and runs a little north of east, crossing the Pennypack just below Huntingdon Valley, and striking the valley of a small stream that passes north of Somerton and flows into the Poquessing. Passing by Browns-ville, or the Trappe, it crosses the Neshaminy at Vansant's mill, runs on the slope below Langhorn's hill, and thence to Andrew Flowers' mill. Here it strikes the bed of the National Railway, of which the grading is partly done, and makes a bee line to the crossing of the Delaware River.

A New International Bridge.

The Buffalo Commercial says that plans and surveys are being prepared for a new bridge over the Niagara River at Grand Island some ten miles below Buffalo. A company has been organized under a charter from the Canadian Govern-

ment. The new bridge on the Canada side is to start from a point a little below the mouth of Black Creek and cross the river to Grand Island nearly at a right angle. It is expected that the American channel will be spanned below Tonawanda, the end of the bridge reaching the shore between the village and the new blast furnace. According to the figures of the directors the two bridges together will be about a mile in length, and the gap between them across Grand Island will be about six miles wide. Provision is to be made for a double track and a double carriage way. The new bridge, it is said, is to be in the interest of the Canadian Southern, which will connect with it by a short branch line from Stevensville to Black Creek. The Great Western has heretofore made some movement towards a bridge at Tonawanda.

Louisville, Cincinnati & Lexington.

It is stated that certain parties are moving for the appointment of a receiver and the reorganization of the company and the foreclosure of the mortgages if necessary to carry out the plan.

Louisiana Central.

The question of voting aid to this road is being discussed at Shreveport, La., and \$300,000 is the sum named. The proposition is to be definitely made by the company shortly and submitted to popular vote.

The Shreveport Times publishes a letter from H. B. Willson, agent for certain English capitalists. Mr. Willson believes that the prospects of the road are fair and that there will be no trouble in securing means, provided some \$7,000 per mile can be secured from local subscriptions.

Chester & St. Louis.

It is proposed to build a railroad from Chester, Ill., north by west to Red Bud, a distance of about 25 miles. At Red Bud connection would be made with the Cairo & St. Louis.

Attleboro & Bristol.

Two lines have been surveyed, and a third and final survey has been ordered. The road will be about seven miles long from Attleboro, Pa., southward to the Philadelphia & Trenton at Bristol. The Pennsylvania Railroad Company will build the road.

Central of Iowa.

At a meeting of the bondholders in New York, July 30, the President of the company, Mr. I. M. Cate, stated that the road had never earned its expenses. The interest had been paid by parties interested until a year ago, when they declined to pay any longer. A majority of the bondholders had agreed to fund five coupons, but a large minority refused. The officers of the company on consultation believe it best that the mortgage should be foreclosed and the company reorganized. The bondholders were requested to appoint a committee to carry on the foreclosure suit.

Resolutions were adopted to the effect that the meeting disapproved of the filing of the bill in the Circuit Court of the United States in Iowa, in the name of Lynde and others, and the opinion of the meeting was that it was inexpedient to have further proceeding continued in that suit. It was also resolved that a committee be appointed, with power to confer with the board of directors, and also to take such steps in reference to a foreclosure as they might deem expedient, and to recommend such plan for reorganization of the company as they might deem best for the bondholders. It was also resolved that the committee be instructed to invite the bondholders interested in the suit of Lynde and others to participate with the other bondholders in their action.

The committee was then appointed as follows: On the part of the first mortgage bondholders—R. S. Ashurst, of Philadelphia; Thomas B. Reed, of Portland, Me.; E. Wetmore, of New York. On part of second mortgage bondholders—J. H. B. Latrobe, of Baltimore; S. T. M. Davis, of New York; Peter Starr, of New York.

St. Louis, Keosauqua & St. Paul.

The Engineer, Mr. R. White, writes to us from Keosauqua, Iowa, under date of July 26, as follows: "After some vexatious delays the Iowa North & South Railroad Construction Company has been organized to build the St. Louis, Keosauqua & St. Paul Railroad. The directors of the Construction Company are E. Manning, J. N. Morton, C. N. Cooper, and Charles Baldwin, of Keosauqua, Iowa; E. Pitkins, Birmingham, Iowa; B. A. Haycock, Richland, Iowa, and N. C. Terrell, Stephen R. Moore and H. C. Clark, of Kankakee, Ill. The officers are E. Manning, President; B. A. Haycock, Vice-President; J. S. Sloan, Secretary, and J. G. Brown, Treasurer. The Executive Committee are E. Manning, B. A. Haycock and N. C. Terrell. N. C. Terrell & Co., who had the contract for building the road from Keosauqua to Fairfield, have assigned their contract to the Iowa North & South Railroad Construction Company, and it is hoped that the work of construction will now be pushed with greater vigor."

Government Caution to English Railroad Companies.

Under date of July 16, the Board of Trade of Great Britain sent to the chairmen of all the railroad companies in Great Britain a circular letter, which says that at this period of the year, when a great increase of traffic is to be expected, and a large number of excursion trains will be added to the regular passenger trains, the Government feel that they cannot too seriously urge upon the railway companies the necessity of availing themselves of all the means in their power to provide for the safety of their passengers. The Board specifies no means of safety except that "they are strongly of opinion that every exertion should be used to enforce punctuality, and that the companies cannot be justified in advertising traffic beyond what the accommodation and staff which they can provide are sufficient to meet."

Lake Shore & Tuscarawas Valley.

In making a statement of the financial condition of this company in our issue of the 25th, we gave the amount of first-mortgage bonds as \$8,000,000, on the authority of Poor's Manual. From the Receiver's office we are informed that the amount is but \$2,000,000, or \$20,000 per mile, which brings with it the important consequence that the net earnings for the year there reported are just equal to the interest on these bonds, instead of two-thirds of that interest, as we stated.

A Land Grant Railroad Decision.

In answer to a question from the Secretary of the Treasury, the Attorney General of the United States has given his opinion that a railroad, existing, unfinished or projected, is defined and identified by its track and termini. When, therefore a grant of land has been made to a company to aid it in constructing, in whole or in part, a railroad between certain termini, upon condition that it shall extend between the points mentioned, any subsequent change of termini will not affect the original application of the conditions.

Joliet & Northwestern.

This company has secured the right of way for 12 miles of the 22 between Aurora, Ill., and Joliet, besides considerable subscriptions to the stock. A meeting in favor of the road was held at Aurora, July 30, and a committee appointed to negotiate for the right of way through that town.

South Side.

Mr. C. L. Burnett, Referee, gives notice that, in pursuance of a judgment of foreclosure of mortgage granted July 14, in a suit brought by the trustees of the first mortgage, he will

sell the road at auction at the Commercial Exchange, Brooklyn, N. Y., August 31.

The road owned is 57 miles long, from Brooklyn, N. Y., to Patchogue, and there is a branch to Rockaway, 9 miles, besides a leased branch, 5½ miles long, to Hempstead. By the latest report the stock was \$1,000,000, the funded debt \$3,250,000, and the floating debt \$968,000. The company has been in embarrassed circumstances some time.

Keithsburg & Eastern.

It is said that arrangements are being made for a connection between this projected narrow-gauge line and the (also projected only) Chicago, Millington & Western.

Des Moines & Minnesota.

This road is now completed from Des Moines, Ia., north to Ames on the Chicago & Northwestern, a distance of about 30 miles. This section was opened for business July 29. It is of 3-foot gauge, and the second line of that gauge in Iowa.

Rockford, Rock Island & St. Louis.

The Henry County (Ill.) Circuit Court, on application of Samuel M. Nickerson, of Chicago, a bondholder, for a foreclosure of mortgage and the appointment of a receiver, has appointed R. B. Cable and Cornelius Lynde receivers, and they have taken possession of the road. Mr. Cable is President and Mr. Lynde Treasurer of the company. It looks somewhat as if this action was intended to head off the suit in the United States Courts and keep the present officers in possession of the road.

Plymouth, Kankakee & Pacific.

A bill for the foreclosure of the mortgage and the sale of this road has been filed in the United States Circuit Court in Chicago. A decree of foreclosure has already been made in Indiana and Phineas M. Kent appointed receiver, and it is desired to have the same thing done in Illinois. The first mortgage bonds outstanding amount to \$400,000, and no interest has been paid since 1872. Most of the road is graded, but no iron was ever laid on it.

Flushing, North Side & Central.

This company has commenced running parlor cars over the road from Hunter's Point to Babylon. The cars make two trips daily on the morning and evening Fire Island express trains.

The amount necessary to secure the extension of the North Shore line to Huntington has been subscribed by the people along the line, and work will probably be begun this fall.

North Wisconsin.

The grading is completed for 10½ miles north from New Richmond, Wis., and the road is ready for the ties.

Bangor & Bucksport.

Col. John E. Gowan, the former contractor, has sued the company for \$100,000 damages on his contract of last year, and has attached all the property, including the rails now at Bucksport, Me.

Lake Simcoe Junction.

This company was organized at a meeting held in Toronto, Ont., recently.

The Illinois Railroad Commission.

The board of Railroad Commissioners met in Springfield, Ill., July 29, and after examining into complaints made resolved to bring new suits against the Illinois Central and Chicago, Burlington & Quincy companies.

Louisville, Cincinnati & Lexington.

The Newport & Cincinnati Bridge Company has brought suit against this company to recover \$30,000 rent due for use of the bridge. The appointment of a receiver is asked for.

Railroad Taxation in Missouri.

Application has been made to the United States Circuit Court now sitting at Davenport, Ia., for an injunction to prevent the collection of taxes from the Chicago & Southwestern Company on the valuation of the road made by the Missouri State Board of Equalization. The application is made by a stockholder.

The Atlantic & Pacific and Missouri Pacific have commenced similar suits and other companies intend to do the same.

Gulf, Colorado & Santa Fe.

A call for an installment of 5 per cent. on the stock has been made, payable August 5. Arrangements have been made for the survey of the first 150 miles of the road.

United States Contracts.

Col. John N. Macomb, Corps of Engineers, will receive proposals a. his office in Keokuk, Iowa, until noon of August 18, for the stone and lime required for the completion of the guard-lock of the canal now in process of construction around the Des Moines Rapids.

The same officer, at his office in Rock Island, Ill., will receive proposals until noon of August 27, for the prosecution of the work of dredging and construction of dams, rip-raps and jetties for the improvement of the Illinois River.

Lieut. Col. John Newton, Corps of Engineers, will receive proposals at Room 31, Army Building, corner of Greene and Houston streets, New York, until noon of August 15, for the construction of dykes in the Hudson River, near Albany.

New Orleans, Mobile & Texas.

In June last a committee was appointed by the New Orleans Chamber of Commerce to suggest some means of completing the Western Division to some point in Texas. The committee reported that the only hope of such completion was that the road should be sold for cash, and by that means prevent the present first-mortgage bondholders from again becoming its owners. Mr. Frank M. Ames, trustee for the bondholders, has already obtained judgment against the road, and the court has ordered a sale to satisfy his demand, when, in all probability, he would become the purchaser and thereby attain what the Chamber of Commerce and others were most anxious to prevent. To this end Mr. Lyman J. Dodge, an interested party, entered suit against the road, when Mr. Ames obtained an injunction from Justice Waite, of the United States Circuit Court, restraining Lyman Dodge from prosecuting any suit against the road or its successors, so far as to affect the possession embraced in the deeds of trust made by the company to plaintiff, and from interfering with the sale ordered by the court in the case of Frank P. Ames vs. the New Orleans, Mobile & Texas Railroad, Wm. P. Kellogg and others. The injunction continues in force until the motions on the original and supplemental bills are heard.

Delaware, Lackawanna & Western—Morris & Essex Division.

The Newark Advertiser says: "Among the improvements contemplated by the Delaware, Lackawanna & Western Railroad Company in the Hoboken yard is the building of a ship canal, to extend from the river to Henderson street, a distance of about 1,800 feet. When completed it will be 100 feet wide and 17 feet deep at low water. Men are already at work on the river end of it, but their progress is necessarily slow, because of the nature of the ground. This canal will greatly facilitate the company in discharging freight and coal. Large warehouses are to be erected along the line of the improvement, and, in fact, a complete revolution is intended in the position and surroundings of the yard. The building of the new freight houses, which were to have been commenced in the Spring of

the present year, was postponed because of the company's failure to get their ferry act through the last Legislature. However, the plans then selected have not been abandoned, but part of the work will be commenced upon the completion of the machine shops in Kingsland, which will probably be early in the fall.

Connecticut Railroad Law.

The amendments to the general law limiting the issue of bonds on a road under construction failed to pass the lower house of the Connecticut Legislature.

Harrisburg & Potomac.

The rails are now laid on a section of this road which extends from the crossing of the Dillsburg & Mechanicsburg road westward along the Yellow Breeches Creek to Barnitz Mills, a distance of 12 miles. The road is ballasted and an excursion train passed over it recently. Depots are being built at Barnitz Mills and at Mount Holly Springs, the principal point on the line, and regular trains will soon be put on. Work on the line westward is being pushed forward, and a branch is being built from near Boiling Springs to Ahl's iron bank.

Pittsburgh & Castle Shannon.

It is proposed to extend this road to Waynesburg, in Greene County, Pa., some 45 miles southward from Pittsburgh.

Denver, South Park & Pacific.

This road is now completed from Denver, Col., southwest to Morrison, a distance of 15 miles. At Morrison there are sulphur springs and other attractions, a large hotel is to be built and it is proposed to build up a summer resort. The road is to be extended to Fairplay in the South Park and thence into southwest Colorado. It is of 3-foot gauge.

Colorado Central.

It is said that work on the line to Julesburg is soon to be resumed, and that arrangements are being made to buy the iron. A section of this line from Golden Junction to Longmont, 39 miles, has been in operation some time.

Pueblo & Salt Lake.

Work has been commenced on the section of this road which is to extend from Pueblo, Col., east to Las Animas, the terminus of the Kansas Pacific's Arkansas Valley Branch.

Denver & Rio Grande.

This company has completed a branch or extension eight miles long from Labran, Col., on the Canon Branch, to Canon City. Trains are now running from Denver to Canon City. The company now has 163 miles of road in operation.

Toledo, Ann Arbor & Northern.

The assignee in bankruptcy has commenced proceedings to compel subscribers to the stock to pay up.

Chicago & Lake Huron.

Application has been made to the Cass County (Mich.) Circuit Court for the appointment of a receiver for this road. The case was put over to August 5, when it was to be heard.

Galveston, Harrisburg & San Antonio.

The mails are laid to Harwood, Tex., 12 miles west of the late terminus at Waelder and 146 miles from Harrisburg, the eastern terminus.

Pennsylvania—New York Division.

The Construction Department, which has had charge of all new work on the New Jersey lines and especially of the Harborside Cove improvements, has been abolished. The work has progressed so far that it will answer all demands for the present, and under present circumstances it is not desirable to begin any new work. The abolition of this department retires Mr. Ashbel Welch, who was Chief Engineer of Construction, but it is said that he will remain with the company as Consulting Engineer.

Easton & Amboy.

A large iron bridge over the Raritan is being put up at Bound Brook, N. J. The track is down from Bound Brook to New Brooklyn, seven miles, making 10 miles laid in all. Track-laying is being pushed forward and two more locomotives have been received. It is said that arrangements have been made for the transfer of passenger business to the Pennsylvania at Metuchen.

Painesville & Youngstown.

The track is laid to Niles, O., 50 miles from Painesville and 25 miles beyond Middlefield, the late terminus. An excursion train will pass over the road August 13, and regular trains will run soon after.

Rhinbeck & Connecticut.

Trouble has arisen as to the crossing of the New York Central & Hudson River road at Rhinecliff. The latter company desires that the crossing may be made on a bridge, but the Rhinbeck & Connecticut wishes to cross at grade. The question has been taken into court.

Baltimore & Drum Point.

The people of Anne Arundel County, Md., voted some time ago in favor of a subscription of \$200,000 to this road, and the Legislature confirmed the vote. The county commissioners, however, have finally voted not to make the subscription.

Indianapolis, Bloomington & Western.

This company proposes to the holders of bonds, both the first-mortgage extension and the second-mortgage bonds, that they should deposit the coupons from July 1, 1874, to July 1, 1876, both inclusive, being five coupons, with William R. Fosdick, as trustee, and receive in exchange certificates of indebtedness payable in seven years from July 1, 1874, and bearing interest. The coupons are to be held by the trustee until the certificates are paid, and the bondholders to recover their original rights in case the interest and principal of the certificates are not paid when due.

No statement of the condition of the company is made or promised, the only explanation of the default vouchsafed being the simple statement that the "board of directors of the company, after consultation and due deliberation, have deemed it expedient and necessary, in view of the present financial condition of the road, caused by large expenditures for equipment, construction of 46 miles additional side track and other extensive improvements on the line of road, all being necessary to accommodate the large accumulating business, together with the inability of the company to dispose of its bonds, consequent upon the general attacks on railroad credits, to submit the proposition for funding."

Wachusett.

Surveys are being made for a narrow-gauge road from the base to the summit of Wachusett Mountain in Northern Massachusetts. The line surveyed is about three miles long, with an average grade of 264 feet to the mile.

Peoria, Atlanta & Decatur.

Work has once more been resumed and the bridging north-west of Atlanta, Ill., is being finished up. The expectation now is that track will be laid from Peoria to Atlanta by September.

Paris & Decatur.

It is stated that Mr. Hervey, the President of this company, on his recent visit to Europe succeeded in raising the money

to relieve the company from its present embarrassments and to complete its road as originally intended.

Flint & Pere Marquette.

Work has been resumed on the extension from Reed City, Mich., west to the Lake Michigan terminus at Ludington. Most of the iron has been delivered at Reed City, and the track will, it is expected, be laid by the end of September.

California Pacific.

There is talk of building a branch line from the California Pacific at Woodland, Cal., north of Colusa, a distance of about forty miles. The line would be parallel with the Oregon Division of the Central Pacific, but from fifteen to twenty miles distant and on the opposite side of the Sacramento River.

Kansas City, Independence & Lexington.

The track of this narrow gauge road is laid from Independence, Mo., west 10 miles to Kansas City. Some opposition has arisen to the route into Kansas City which the company had adopted, and an injunction has been obtained prohibiting it from entering the city on that line.

Delaware River & Bound Brook.

The engineers have completed the location of the bridge over the Delaware River, which is near Yardleyville. Nearly the whole line is now located from the Delaware to Bound Brook.

Camden & Atlantic.

This company has made arrangements for an exchange of passenger traffic at the intersection of its road with the Amboy Division of the Pennsylvania in Camden, N. J.

The Connecticut Railroad Commission.

The bill reorganizing the Commission and giving the appointment of its members to the Governor passed the Connecticut Legislature with the amendment retaining the present Commissioners in office till their respective terms expire. This leaves the Governor one vacancy to fill this year. It is said that he intends to appoint George M. Woodruff, of Litchfield, a well-known lawyer, to the position.

Contributions.

Journal Friction.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Your article on "Journal Friction," in your issue of July 18, is evidence that the theme is not yet exhausted, and is welcomed by myself, and no doubt others, who are on the fence waiting to hear the matter thoroughly discussed before making their decision as to the propriety of adopting the so-called "standard car axle." While we are waiting for the results of actual trial by the parties who have the large axles in use, it will be no loss of time to discuss the subject thoroughly and endeavor to harmonize theory and practice.

There are some points in your article which are not clear to my mind, and on which probably you can enlighten me.

By what process of calculation do you establish the formula given for the weight allowable on each square inch of journal? I find that Bourne, in the "Hand Book of the Steam Engine," gives a similar empirical formula, which allows from 50 to 65 per cent. greater pressure than does yours. It reads as follows: "To the constant number 50, add the velocity of the bearing in feet per second and reserve the sum for a divisor; divide the constant 70,000 by the divisor found as above, and the quotient will be the number of pounds per square inch that may be safely put upon the bearing."

I give the results obtained by the two methods:

Velocity of periphery of Journal.	Limiting pressure per square inch of bearing surface.	
	RAILROAD GAZETTE.	BOURNE.
1 foot per second.....	382 lbs.	382 lbs.
2½ feet per second.....	224 "	350 "
5 feet per second.....	140 "	233 "

I am loath to charge you with having abandoned your former position and gone over to the camp of the "small journal" party, but a paragraph which I quote would seem to indicate it. You say: "The work required to overcome friction will be greater with a large than with a small journal, because the distance passed through by the periphery in a given time will be greater in the former case."

Mr. Leander Gary vouches for the following statement: "A passenger car weighing 44,674 lbs. and fitted with 3¼ inch journals required a force of 800 lbs., as shown by a dynamometer, to move it along a level track as slowly as the engine could be made to move. Another car weighing 46,770 lbs., and with 3½ inch journals, required just 700 lbs. to move it on same track and at same speed." Mr. Towne, of the Northern Pacific Railroad, stated in the recent Master Mechanics' Convention that it required much less power to push a locomotive truck with large journals through the yard than the same kind of truck mounted with smaller axles. Now in both these cases there was not sufficient velocity to develop heat sufficient to destroy the lubricant. How can we reconcile these statements with the axiom that you lay down—that the work of friction is increased by increasing the diameter of the journal?

In your remarks upon the accumulation of heat by friction, I think you point the way to a correct solution of the large journal problem. But even here you seem to give aid and comfort to the "small journal party," when you say that, "if their length is the same, the tendency of journals to heat is entirely independent of their diameters."

Do you not make a mistake in stating that the superficial area of a journal is the measure of its capacity to dissipate the heat arising from friction? It seems to me that the cubical dimensions of the journal are available for conducting away the heat to the wheel and center of axle, where it is radiated; and in that case, if it is admitted, that the work to overcome friction, and consequently the heat, increases with the diameter of the journal, then the capacity for conducting away the heat increases as the square of the diameter; so that if we have two journals of three and six inches diameter respectively and of same length, making the same number of revolutions and loaded with the same weight, the work necessary to over-

come friction—and consequently the heat of the six-inch journal—will be twice that of the small journal, but the accumulation of heat will be greater in the latter, as its ability to conduct away the heat is only one-fourth that of the six-inch journal. No account is now taken of the radiating and conducting capacity of the journal and oil-boxes.

Please give us more light on this befogged subject, Messrs. Editors; but don't go back on the "big journal" people.

C. R. P.

General Railroad Conventions as Failures.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Within the last five years quite a number of general railroad conventions have been held, but according to my information and experience every one has proved a failure; so far from having had a progressive influence on railroad policy, they seem to have left behind them a demoralizing effect. As convention after convention was held, apparently only to further demonstrate the fact that railroad managers would not abide by the compacts they entered into, a despair settled on those who meant well; it is therefore not astonishing that now, no matter by whom a convention is asked for, the attendance is meagre, being composed of enthusiastic young officers whose blood has not yet been de-vitalized by the fatal convention upon tree, and a sprinkling of older ones actuated by motives other than that of hope—such, for instance, as personal respect for or deference to the party desiring the meeting.

A noteworthy assembly having just adjourned, important by reason of the rank of the callers, but which has as yet given no more promises of vigor than its predecessors did, it may be opportune at this time to inquire into the causes of failure. Before entering on this review, we must premise that by public admission of the parties themselves it is conceded that among railroad managers there is a unanimous want of faith in each other—veritable Ishmaelites do they believe themselves to be. Here arises a question: Is the demoralization of railroad managers a cause or a consequence of the failure of conventions? I take it to be a consequence, for I cannot bring myself to believe that the men intrusted with the interests of railroad companies are as a class mendacious; I see no reason for thinking so. It cannot be denied that agreements have been broken and that solemn asseverations have proved inconstant, yet in the majority of cases mitigating circumstances probably exist. Black sheep there are in every fold; the constituent elements of human nature never vary; even the class that claims to have been regenerated and to be upheld by supernatural grace furnishes its full complement of scoundrels. Why, then, should we expect that a class of men exposed to peculiar temptations, harassed by innumerable difficulties, picking their way, as it were, through a field covered with snares while being pursued by a pack of hungry wolves—why should we expect of them an unusual share of virtue?

In order to arrive at a correct understanding of what was attempted to be done at the conventions under investigation and to ascertain what elements were present, we should have the records before us. The men who have taken part in the proceedings are men who handle revenues and command resources greater than those of some European potentates. From such men we expect method, business-like habits and statesman-like foresight. We have a right to suppose that the efforts of such men to bring about a reform or to procure the execution of certain arrangements or contracts would be exerted in a systematic, persistent way, and that a record would be kept of the proceedings, carefully preserved in some designated repository; but we find nothing of the sort, and here we have the first evidence of that want of method which has characterized all of the conventions. Here and there amid cobwebs and time-dyed documents some lucky chance reveals a report from which we are enabled to glean scant information concerning the occurrences at a convention. Of these rare documents such as have passed through the hands of the writer indicate that throughout the proceedings of these meetings there was a want of method and of character. Modern conventions are marred by the same defect. The manner of conducting the business is substantially as follows: From one to two hours after the time fixed for the opening of the session, the members begin to assemble. After a while the spirit moves somebody to suggest that they should proceed to business; a chairman and a secretary are chosen; a list of the persons present is made by the latter; some one explains the reason for asking the gentlemen to meet, lays the grievance before them and requests that they deliberate thereon; then follows an interval of silence. Apparently any one may be present at these assemblies and any one may speak and any one may vote. At least no rules are laid down regulating such matters. Practically very few speak and nobody votes. When a question is put, the chairman has to decide that as he saw several eyes but heard no nose, therefore the eyes have it. One of the uninitiated might suppose that a general convention being assembled at the request of some party or parties for a specific object, those persons would have prepared for consideration of the meeting an elaborately drawn scheme, complete in all its details; but the man who "has been there" knows better. If there is any one thing more than another that railroad men hate it is detail; they are grand architects of Mansard roofs, seemingly forgetful of the fact that no edifice, however stately or high-toned, can be raised without the vulgar aid of the bricklayer, the mason and the carpenter.

After the case has been stated, a desultory discussion, or rather conversation, ensues: a committee is then appointed and given two hours to study the matter, which of course is one of great intricacy (else a convention would be unnecessary), and to prepare a panacea. The meeting then adjourns for a couple of hours; when it reassembles the committee reports, usually a design for another Mansard roof. A debate ensues, the members yawn, tilt back in their chairs, rub their

eyes, drink iced water and suddenly remember important engagements. The report of the committee, necessarily vague from the scantness of time allowed to its preparation, is talked over in convention still more vaguely, and finally agreed upon by a bare quorum; points liable to bring about a fight are touched on lightly and deferred; finally the Chairman and Secretary are appointed a committee to carry out the recommendations of the convention, which adjourns *sine die*. The members hurry home; the Secretary and the Chairman sometimes reside several hundred miles apart, and have little sympathy with each other; they, too, hurry home; they may or may not be enthusiastic individuals; in the former case they do their best, but ere long a difficulty occurs which they have no power to adjust; they are authorized only to present the resolutions of the convention to certain parties for ratification, the convention has adjourned *sine die*; so the scheme soon dies.

Here, then, surely we discover some of the causes of failure. The constitution of the convention is chaotic, its productions are crude, its resolutions are ill-considered and do not necessarily represent the views of even a majority of the members, no proper machinery is provided to carry out the desires of the convention and to adjust unforeseen difficulties.

These statements seem absurd; it is almost impossible to imagine ordinary business men going through such a farce, much more extravagant to conceive that those whom *The Nation* says are the most talented business men of the country, could permit such trifling. Nevertheless the facts are not exaggerated, so far as my information and experience go, which I believe cover nearly all the important general meetings within the last five years. There is yet another cause that suggests itself just now, which is that attempts have been made to conclude compacts in convention regardless of the contingency that the members may not all be despots, that their action may not be upheld by those to whom they are responsible; and if, unfortunately may be, any of the members are thus overruled, the cry of bad faith is immediately set up. Again, after the compact is agreed to and the contract executed, sufficient time is not given to enable the parties to carry out its provisions. Said an official not long ago, "I used to be a promoter of conventions and worked hard at them, but I don't do so any more. The last meeting I attended was when Sam Sloan was crowned Dictator. We then arranged everything satisfactorily, but the members had not reached their homes before the compact was violated. Since that time I have eschewed conventions." This statement gives a fair idea of the temper of the reformers. The reform must begin at once. The compact must be concluded now and "go into operation immediately." Then if before the parties to it can re-arrange their system, or rather their no system, of doing business, some subordinates with suspicious zeal do wrong, the principal is at once charged with bad faith, and reprisals begin.

All arrangements which require the concurrence of several railroad companies are important enough to be worthy of calm thought and mature deliberation, to which the heated atmosphere of a convention is not congenial. It is not seemly for any prominent man to press his views of the matter or to be conspicuously active in attempting to bring about any particular reform. At any rate he would by such a course render himself liable to the charge of axe-grinding and would probably be misunderstood. Pride as well as prudence counsel against such activity, for in that case the failure of the movement would be a source of mortification.

To reduce the reform movement to a system, conventions should be governed by fixed rules, some of which are suggested as follows:

1. The aggrieved party, or the party desiring to attempt a certain reform, should prepare an elaborate paper containing a statement of the grievance and the proposed remedy, which paper should be submitted to all the parties concerned and time given them to study it.
2. After the statement has been submitted, the opinions and desires of the parties concerned should be elicited as far as practicable and their willingness to meet in convention ascertained. If the absence of any party might make the meeting abortive, it would be wise to be assured of their co-operation before issuing the call.
3. The place of session should be that chosen by a majority of the parties interested.
4. Only persons properly authorized as representatives of the contracting parties should be permitted to take part in the proceedings. Subordinates and assistants might be in waiting and be examined by the convention if necessary.
5. No attempt should be made to conclude an agreement while in session. A convention may discuss and recommend, but inasmuch as no compact should be entered into without the clearest comprehension of its provisions and a determination to carry it out in good faith and to exercise forbearance, the deed of agreement after being drawn up should be reconsidered and, if accepted, executed by the highest contracting authority, that is, in most cases by the board of directors.
6. The secretary should be a person who has a personal interest in carrying out the desires of the convention. As a rule, honorary and temporary secretaries are bad ones, because they are in a measure irresponsible and are liable to become incapacitated at any stage of the negotiations. The secretary should be experienced in this particular line and should be continuously in office, so that derangement or demoralization may not supervene the moment an obstacle rears its ugly head in the path of progress, and in order that he may keep track of the negotiations and report progress from time to time.
7. When the convention has adjourned there should be left somebody authorized to act and, if necessary, to recall the members. Also a body that shall act as an arbitrator, to whom appeal should be made before reprisals are commenced, and which should have power to award damages.
8. The records of the convention should be carefully pre-

served in some designated repository to the end that the efforts at reform may be systematic and persistent, not spasmodic and chaotic.

Without the observance of some such rules as these, conventions cannot succeed. The essential points are: 1, deliberation; 2, completeness of detail; 3, ability of contracting parties; 4, clear comprehension of the provisions, avoiding all ambiguities; 5, persistence; 6, negotiation by parties not personally interested in the compact, but personally responsible for the proper conduct of the negotiations.

These conditions can be secured only through permanent organization, officered by individuals of standing, whose sole time is devoted to the duties connected therewith, and who are not materially interested in any railroad project or company. Such an organization or association should be supported by all the principal railroad companies of Canada and the United States, and should be used in every instance in which any company desires to bring about joint action for the common weal. It should be one of the duties of the officers of the association to study and to devise plans for the rectification of abuses and to harmonize "Kilkenny cats." The chief officer of such an association, call him President, Secretary, or what you will, should be one who can command attention and a hearing in a calm, impressive manner—such, for instance, as Mr. J. H. Deyereux. The exclusive services of such a man cannot be obtained at a small salary, but probably would be worth more than would have to be paid.

This communication, Mr. Editor, is written as it were on the wing; the whistle of the locomotive warns me that the wheels of time are rolling rapidly, and that express trains wait for no man. While there are other causes of the failure of conventions to inaugurate reform, I have accomplished my purpose of pointing out the causes that lie in the convention itself and the remedy. I do not know whether there is any remedy but time and suffering for the other causes.

HINDOO.

Remarkable Locomotives.

22 COOPER UNION,
NEW YORK, August 1, 1874.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In the last number of your GAZETTE is a communication, giving the dimensions of what the writer believes to be the smallest locomotive in the world, and stating that he would like to learn through your columns if there is a smaller.

In *Engineering* of Nov. 26, 1869, will be found an illustration of the "wee" locomotive "Topsy." It has 1½ in. cylinders and 1½ in. stroke, the coupled wheels being 4 in. in diameter. The weight of the engine, empty, is 54 lbs., or, say half a hundred weight. In steam the weight is 60 lbs. The "Topsy" draws a load of eight little trucks up the line, (which has an average inclination of 1 in 16, with a maximum gradient of 1 in 11, and there is one curve of 9 ft. radius) and in all respects conducts itself with the propriety of engines of larger growth.

D. R. GARDEN.

A Mechanical Laboratory.

The following is the report of the Committee of the American Society of Civil Engineers on Founding a Testing Laboratory, adopted June 30, 1874:

The Committee appointed to consider and report upon the proposal to establish a "Testing Laboratory" in connection with the Stevens Institute of Technology, as set forth in the correspondence between Prof. Robert H. Thurston and the Trustees of the Institute, respectfully report as follows:

After careful consideration of the subject, the Committee is of opinion that the proposal possesses great merit, and should be encouraged by the American Society of Civil Engineers for the following reasons:

1. Because it would afford a ready means of settling authoritatively many questions which come up in daily practice, and upon which there is now considerable difference of opinion.
 2. Because it would substitute for individual efforts and experiments an organized body through which engineers could carry on desirable investigations.
 3. Because this laboratory being connected with an institute of such high reputation as the Stevens Institute, and being managed by purely professional men, it would be removed beyond mercantile influences, and results published under its seal would be received with a degree of confidence otherwise unattainable.
 4. Because, if prudently and economically managed, the cost of experimenting would be largely reduced, and the duplication of experiments avoided.
- For these reasons the Committee believes that the Society should take a share in fostering and organizing the project. There are, however, many other interests and bodies to be consulted; railroad officials, manufacturers and managers of metallurgical works, chemists and mining engineers are interested in the matter quite as much as civil engineers, and no plan of organization would be complete unless they were conferred with. The Committee, therefore, recommends that the Society appoint a special committee to consider the subject further, to meet with such other parties which have been mentioned, and discuss a plan of organization, and the ways and means for carrying it out, with instruction to report the same to the Society for its action thereon.

Respectfully submitted,

O. CHANUTE,
ALF. P. BOLLER,
RICHARD H. BULL,
Committee.

The Proposed Mechanical Laboratory.

The following communication shows that something has actually been done towards establishing the proposed laboratory:

HOBOKEN, N. J., May 1, 1874.

To Prof. R. H. Thurston, Stevens Institute of Technology:
SIR: The Trustees, after a more thorough consideration of your letter of January 30, referring to the necessity of a laboratory devoted to technical research, and especially designed to meet the necessities of the industrial interests of the country, have decided to assume the initiative, and to endeavor to provide the nucleus of such an institution as that proposed in your letter just referred to.

You are, therefore, authorized and requested to organize a mechanical laboratory, as an adjunct to your department, and to assume the direction of its affairs.

You will take charge of such contributions as may be made by those interested in the creation of such an establishment, whether of apparatus, of machinery, or of capital, and account for them to the Trustees.

In accepting such contributions you will submit to the Trustees the proposed conditions of acceptance before completing any agreement with the contributors.

You will, in the expenditure of funds, in the erection of buildings, the purchase and establishment of apparatus and machines, and in the employment of subordinates, use every precaution to secure the greatest economy, and a full equivalent for funds so used.

You will establish all necessary regulations for the successful operation of the new department, and will provide such a schedule of charges for work done for private parties as shall cover actual expenses and give a margin of profit, amounting to not less than 20 per cent. of such expenses, which profit shall be charged to a capital account for the purpose of securing a gradual increase of the stock of apparatus, and the accumulation of a fund which may ultimately be used in the erection of buildings, and in securing enlarged facilities for special researches.

In making regulations for the guidance of those having occasion to avail themselves of the facilities, which it is proposed to provide for the examination of materials and for research, you are desired to make provision, where possible, for a fair return upon their investments to those who may aid in the establishment of the laboratory.

You will make a report to the Trustees in January of each year, in which you will state the amount and the character of work done during the previous year, the condition of the department, its growth and its wants.

You will be expected to render an account of receipts and expenditures semi-annually, January 1 and July 1, and in the statement, which shall accompany the annual report, you will give an account of stock, and a statement in full of the value of all property held on laboratory account.

The Trustees of the Stevens Institute will transfer to the Director of the Mechanical Laboratory the following property, to be held and used for the benefit of said laboratory:

- 1 Steam Engine of 4-horse power.
- 1 Engine Lathe of 15-inch swing.
- 1 Speed Lathe.
- 1 Power Planing Machine, 5 feet bed.
- 1 Small Hand Planing Machine.
- 1 Universal Milling Machine.
- 1 Upright Drill.
- 1 Emery Grinder and Wheels.
- 1 Set of Taps and Dies.
- 1 Set Reamers.
- 1 Set Whitworth's Gauges.
- 1 Lot Miscellaneous Tools, as per inventory to be submitted.
- 1 Testing Machine, with autographic registry, to break iron or steel $\frac{1}{2}$ inch diameter.
- 1 Emerson Dynamometer.
- 1 Sallern Dynamometer.
- 1 Woltman Mill, for determining velocity of streams.
- 1 Baumgartner for determining velocity of streams.
- 1 Wheel, with Dial for determining the velocity of water.
- 1 Pilot Tube for determining the velocity of water.
- 1 Anemometer.
- 2 Richards Steam Engine Indicators.
- 1 MacNaught Steam Engine Indicators.
- 2 Spring Balances, British Measure.
- 1 Spring Balance, French Measure.
- 1 Blacksmith Forge.

To the above list there will be appended some other apparatus as yet unselected, the whole having an estimated value of \$5,000.

The boilers of the Institute will be allowed to furnish steam to drive the engines and tools.

The Trustees will assume charge of permanent funds, and will endeavor to invest them properly. They will decide when it may be advisable to expend all or any portion thereof for the purpose of enlarging the field of usefulness of the institution for the benefit of which they may have accumulated.

You are authorized to make use of such available space within the building of the Institute as shall be necessary for the accommodation of the proposed Institute, and to call upon the employees for such assistance as may be needed, whenever such aid may be rendered without interfering with their regular work, or their duties to the officers of the Institute. It is presumed that such assistance will meet all requirements for several months at least.

Whenever it shall occur that a total subscription of sufficient amount to erect buildings shall have been received the Trustees will further appropriate to the use of the proposed mechanical laboratory a strip of land adjacent to the Stevens Institute of Technology, not exceeding 200 feet in length and 50 feet in breadth, valued, at present prices, at not above \$20,000, on which such buildings may be erected.

The total appropriation thus made is to be credited to the Institute as a shareholder, for its amount, \$25,000. The Trustees will also hold themselves in readiness to share the management of the laboratory with a Board of Trustees, of which the President of the Stevens Institute shall be *ex-officio* President, and on which Board contributors shall have representation in proportion to the aid given; this transfer to take place whenever the majority of stock representing subscriptions shall vote it advisable.

[Signed,]
S. B. DOD,
W. W. SHIPPEN,
Trustees.

ANNUAL REPORTS.

Mexican.

At the annual meeting in London, June 30, a report was rendered giving the following facts:

The total length of the company's road, including a branch to Puebla in addition to the main line from Vera Cruz to Mexico, is 292 $\frac{1}{2}$ miles, which was all in operation except during the first 22 days of January, when a considerable section between Vera Cruz and Mexico was not ready for traffic. The earnings were:

Passengers.....	291,744
Merchandise.....	247,555
Pulque.....	52,857
Sundries.....	31,857

Total (\$1,448 per mile).....\$233,510
Working expenses (60.95 per cent).....258,132

Net earnings (\$573 per mile).....\$165,378

During the first half of the year the earnings per train-mile were 13s. 1d. and the expenses 7s. 6d. During the second half the earnings were 11s. 10d. and the expenses 7s. 9d., the expenses thus rising from 57 $\frac{1}{2}$ per cent. in the first half to 65 $\frac{1}{2}$ per cent. in the second half. The company also, in accordance with its contract, received £126,298 from the Mexican Government, or about half as much as the net earnings. The whole net income was thus about £1,000 per mile, which would be very satisfactory from a road of moderate cost, but is not more than 2 $\frac{1}{2}$ per cent. on the cost of the Mexican Railway.

In accordance with a contract made during the year, which embraced some changes in the tariff, the company became possessed of the work already done and of the concession for the railroad from Tejeria to Nopalucan, via Jalapa, which it is now completing, for which purpose it has executed a mortgage for £520,000 and issued one-half of the amount.

LOCOMOTIVE RETURNS, JANUARY, 1874.

Master Mechanics of all American railroads are invited to send us their monthly reports for this table.

NAME OF ROAD.	Number of miles operated.	Number of Locomotives in service.	Mileage.	No. Miles run to Ton of Coal.	Cord of Wood.	Pint of Oil.	Cost per Mile in Cents for					Average cost of Coal, per ton.	Wood, per cord.
							Repairs.	Fuel.	Stokes.	Miscellaneous.	Total.		
Atlantic & Pacific and leased lines.....	222	292,285	31.84	14.77	5.36	8.78	0.65	7.12	21.79	\$.75	\$2.46		
Atlantic & Great Western (First & Second Div.).....	228	227,102	39.73	15.38	4.35	7.24	0.67	6.30	19.49	2.73	3.82		
" " (Third & Fourth Div.).....	209	130,574	39.73	15.21	3.32	7.34	0.60	6.12	18.52	2.73	3.82		
" " (Mahoning Division).....	113	126,853	39.73	17.06	3.58	7.34	0.51	6.05	18.28	2.73	3.82		
" " (Shenango & Allegheny).....	33	13,063	45.26	19.52	0.97	7.85	0.41	6.01	16.03	2.73	3.82		
California Pacific.....	148	34,112	43.35	20.09	3.00	17.03	0.63	6.70	27.36	2.73	3.82		
Central Pacific (Western Division).....	173.4	102,600	46.38	12.72	9.76	16.09	1.00	8.19	25.04	7.05	4.61		
" " (Sacramento Division).....	119.5	99,129	29.33	15.49	17.25	16.7	0.80	8.41	23.21	7.05	4.61		
" " (Truckee Division).....	204.5	62,985	36.33	50.00	6.37	17.85	0.66	8.56	33.44	7.05	4.61		
" " (Humboldt Division).....	236.6	59,087	39.82	14.30	4.05	17.8	0.8	7.80	29.81	7.05	4.61		
" " (Salt Lake Division).....	182.8	67,670	34.31	14.96	4.43	19.81	0.81	8.15	36.20	7.05	4.61		
" " (Oregon Division).....	151.48	19,602	56.31	44.01	7.61	11.24	0.60	7.77	24.12	7.05	4.61		
" " (Vi. alia Division).....	188.3	19,602	56.31	18.01	4.94	14.12	0.70	8.46	28.22	7.05	4.61		
Chicago, Burlington & Quincy.....	288	665,342	33.00	19.65	5.67	9.74	0.58	8.51	24.50	3.50	4.25		
Chicago & Northwestern (W. & Mil. Div.).....	90	334,063	26.67	17.97	7.76	14.14	0.90	8.30	31.21	3.50	4.25		
" " (Madison Division).....	32	105,419	35.95	17.97	5.07	10.40	0.90	7.63	24.00	3.50	4.25		
" " (Galena Division).....	80	215,445	29.11	17.97	6.93	12.14	1.12	9.18	29.37	3.50	4.25		
" " (Iowa Division).....	74	189,897	24.09	17.97	6.3	14.32	0.90	8.65	30.20	3.50	4.25		
" " (Per. insula Division).....	18	27,618	25.56	17.97	6.43	16.2	0.98	9.18	32.82	3.50	4.25		
" " (W. & St. Peter lines).....	80	104,001	34.55	17.97	3.54	12.90	0.90	7.11	24.45	3.50	4.25		
Chicago, Rock Island & Pacific (Iowa Division).....	108	257,066	33.03	18.11	5.54	8.08	0.51	6.86	20.99	2.75	4.00		
Cleveland, Col. & Ind. (Columbus Div.).....	138	66,141,776	42.25	13.12	5.66	8.59	0.58	6.96	21.79	2.75	4.00		
" " (Indianapolis Div.).....	207	66,222,038	41.21	13.12	3.04	7.5	0.51	7.28	18.28	2.75	4.00		
" " (Cincinnati Div.).....	130	28,71,793	37.08	25.44	3.23	8.37	0.59	8.01	20.19	2.90	3.50		
Cleveland & Pittsburgh.....	88	146,115	50.95	16.34	5.01	4.97	0.75	7.14	17.27	2.25	3.85		
Del., Lacka. & West. (Bloomington Div.).....	80	52,010	40.12	26.61	5.39	4.98	0.70	6.71	16.81	2.00			
Denver Pacific.....	23	16,886	50.02	15.64	1.38	7.16	0.44	6.76	15.68	3.75	6.13		
Flint & Pere Marquette.....	63	61,603	45.81	23.10	1.21	9.82	0.75	6.94	18.72	4.80			
Illinois Central (Chicago Division).....	282.50	142,941	36.87	14.20	9.09	5.38	0.50	6.96	21.82	1.90	4.35		
" " (South Division).....	32	75,334	35.5	12.80	7.04	8.81	0.39	6.78	20.06	1.90	4.35		
" " (North Division).....	45	121,011	28.55	13.76	6.22	6.92	0.41	6.4	20.06	1.90	4.35		
" " (Iowa Division).....	39	105,67	30.26	10.91	5.32	7.94	0.46	6.66	20.32	2.30	4.85		
Indianapolis, Bloomington & Western.....	96	179,990	44.60	15.50	3.96	6.71	0.94	8.4	20.05	2.91	3.50		
International & Great Northern.....	89	89,705	44.90	15.50	2.80	7.70	0.9	8.4	19.86	3.50			
Kansas Pacific.....	121,805	33.18	12.38	8.0	11.52	0.6	6.92	27.13	3.75	4.07			
Lake Shore & Michigan South. Buffalo Div.*.....	80	226,120	45.2	47.44	5.36	7.56	0.5	6	18.60	3.50	4.00		
" " (Erie Div.)*.....	113	269,040	45.66	2.50	3.37	7.65	0.5	6.05	17.07	3.50	4.00		
" " (Toledo Div.)*.....	74	210,128	38.35	15.82	3.44	9.62	0.5	7.3	20.42	4.00	4.00		
" " (Mich. South Div.)*.....	208	475,550	39.56	16.94	5.09	9.12	0.5	7.14	21.35	4.60	3.50		
Louisville & Nashville (Main Stem).....	356	84,159,084	33.04	14.14	5.06	11.15	0.55	8.08	27.05	0.128	2.95		
" " (Clarksville Division).....	128.4	12	21.28	21.00	10.0	11.56	0.6	8.18	33.41	0.128	2.95		
" " (Memphis Division).....	130.4	20	42.060	33.17	10.00	11.56	0.6	3.12	38.41	0.128	2.95		
" " (Nash. & Decatur Div.).....	122	20	44,004	30.24	17.4	9.19	0.67	2.85	73.329	0.143	3.65		
" " (S. & N. Alabama Div.).....	183	27	80,095	37.52	5.43	7.15	0.8	9.3	83.277	0.11	2.35		
Leavenworth, Lawrence & Galveston.....	203.7	18	22,676	50.17	29.72	4.52	8.60	6.93	20.52	4.00	5.00		
Marquette, Houghton & Ontonagon.....	9	14,341	60.83	18.61	19.03	12.26	1.12	12.92	45.93	per bu.			
Pennsylvania (New York Division).....	119.9	117	280,611	26.01	34.48	1.5	16.30	1.1	18.81	0.20	6.96		
" " (Amboy Division).....	154.2	69	117,721	45.44	36.90	11.73	0.77	5.39	13.10	0.20	6.96		
" " (Belvidere Division).....	84.6	33	66,773	40.36	49.26	1.30	0.50	14.60	1.30	0.20	6.96		
" " (Philadelphia Division).....	204.3	155	384,576	31.80	14.37	1.90	6.59	0.80	9.20	0.07	3.78		
" " (Middle Division).....	131.6	129	340,36	28.64	18.45	4.30	7.10	0.7	12.10	0.07	3.78		
" " (Pittsburgh Division, East End).....	92	169,307	20.35	8.56	6.30	10.00	1.30	17.61	0.07	3.78			
" " (Pittsburgh Division, West End).....	127	257,854	31.10	12.47	3.70	6.8	0.94	11.10	0.07	3.78			
" " (Tyrona Division).....	100.3	28	43,406	31.4	1.90	6.60	0.8	9.30	0.07	3.78			
" " (West Pennsylvania Division).....	103.6	32	68,953	34.67	21.55	4.80	6.00	0.6	11.40	0.07	3.78		
" " (Lowistown Division).....	92.5	9	13,170	47.43	17.6	6.60	4.50	0.9	12.0	0.07	3.78		
" " (Bedford Division).....	56.5	6	10,730	50.92	20.24	8.70	4.20	0.70	13.60	0.07	3.78		
Philadelphia, Wilmington & Baltimore.....	72	137,816	51.52	10.65	7.10	12.10	1.10	7.20	29.50	5.50	5.00		
Pitts., Fort Wayne & Chicago (Eastern Div.).....	468.9	178	465,941	39.17	13.87	2.53	6.43	0.61	9.90	6.37	16.84	2.52	2.92
" " (Western Div.).....	280	118	380,000	38.10	23.80	4.30	8.40	0.50	6.30	19.50	2.75	3.35	
Pitts., Cin. & St. Louis (Little Miami Div.).....	30	99,444	39.70	13.40	5.00	8.30	0.80	2.30	70.23.00	2.75	3.45		
St. Louis & Southeastern (St. Louis Div.).....	60,755	64.40	10.05	6.05	3.00	0.80	0.88	7.15	17.08	2.10			
" " (Nashville Div.).....	60,239	34.80	8.40	5.60	4.25	0.90	0.90	8.00	18.75	1.75			
Selma, Rome & Dalton.....	23	48,510	47.10	16.70	5.20	4.30	1.10	7.80	18.41	2.60			
South Carolina.....	37	78,743	36.86	27.03	6.78	7.37	0.70	14.55		2.80			
Toledo, Wabash & Western.....	476,301	44.88	13.08	13.08	5.76	5.93	0.64	1.33	5.33	18.89	2.90	3.60	

* Switching engines allowed 6 miles per hour.

The report makes a statement also of the earnings of the current year down to the 25th of April. They amounted to \$187,948 against \$124,018 for the same period in 1873, showing an increase of 51 $\frac{1}{2}$ per cent.

St. Louis, Kansas City & Northern.

This company operated during the year ending January 31, 1874, the following lines:

Lines owned:	Miles.
St. Louis to Hannibal & St. Joseph Junction, 9½ m les from Kansas City.....	265½
Moberly, Mo., to Iowa line near Coatesville.....	87½
Total owned	353
Lines leased:	
Hannibal & St. Joseph, Junction to Kansas City.....	9½
Booneville & Boone County, Centralia to Columbia.....	22
St. Louis & Cedar Rapids, Iowa line to Ottumwa, Ia.....	43½
Chillicothe & Brunswick, Brunswick to Chillicothe.....	36½
St. Louis, Council Bluffs & Omaha, Chillicothe to Pattons- burg.....	41½
St. Louis & St. Joseph, North Lexington to St. Joseph.....	76½